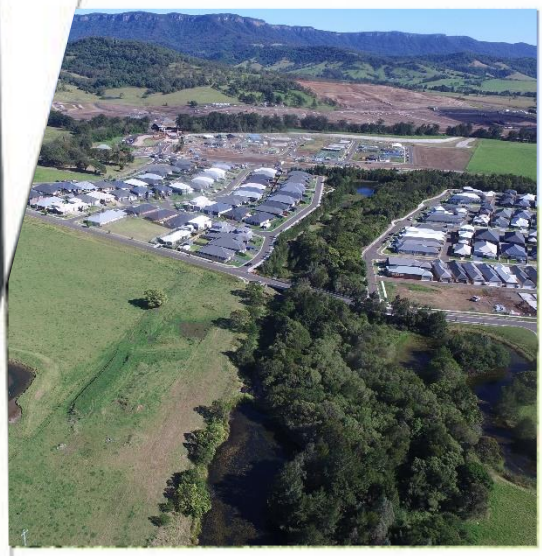
Response to Secretary's Environmental Assessment Requirements (SEARs) - Traffic & Transport Report

Calderwood Urban Development Project
Town Centre Yield Review

8201819401



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Lendlease

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Cardno

Contact Information

Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

16 Burelli Street
Wollongong NSW 2500
Australia

Phone +61 2 4228 4133
Fax +61 2 4228 6811

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Author(s):

Ali Raza
Traffic Engineer

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Approved By:

Tim Sullivan
Manager – Traffic and Transport Planning

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Executive Summary

This report addresses the Secretary's Environmental Assessment Requirements (SEARs) in relation to a proposed yield increase at the Calderwood Urban Development Project (CUDP), located in Calderwood Valley, NSW. Specifically, the report addresses traffic and transport impacts associated with a modification to the Calderwood Concept Plan to increase the number of residential dwellings from 4,800 to approximately 6,500.

Lendlease is the developer of the majority of the CUDP, controlling approximately 600 ha out of a total site area of 700 ha. Other areas of land within the boundaries of the Approved Concept Plan are owned by and to be developed by separate entities. Lendlease has commenced the development of its component of the overall CUDP, and will continue to develop the project in stages over the 15-20 years. To date Lendlease has obtained development consent for some 1,200 dwellings and lodged development applications for another 650. Other developers have also lodged development applications for a further 824 lots on land within the Concept Plan boundary that Lendlease does not own or control.

The proposed modification to the Approved Concept Plan seeks to increase the total provision of housing within the overall CUDP to respond to market demand for the provision of smaller housing types and lot sizes at affordable price points and to ensure the efficient use of urban zoned land for the supply of housing. There is no substantive change between the proposed modified development and that envisaged by the Approved Concept Plan in respect of approved land uses, the urban structure of the development, the road and pedestrian network within the site, the overall range of dwelling types to be provided, nor the scope of environmental protection outcomes for the land.

Within the Approved Concept Plan framework, the proposed increased dwelling yield will be achieved via the delivery of a greater diversity of dwelling types and lot sizes within the R1 General Residential and B4 Mixed Use zones generally as follows:

- Within the R1 General Residential zone, additional yields will be achieved through the delivery of a more diverse range of housing types such as seniors housing and integrated housing and also by a different mix of lot sizes than was anticipated at the time of the Approved Concept Plan in 2010 (including a greater number of smaller lots) to respond to the changing and more diverse market expectations and housing affordability pressures;
- Within the B4 Mixed Use zone, the number of dwellings to be provided will be increased through the provision of a combination of more shop top housing, mixed-use development and stand-alone residential development.

From a traffic and transport perspective, the focus of this assessment has been to assess the impacts of higher traffic generation arising from the increased development yield proposed for the Lendlease controlled land. Given the greenfield nature of the site, and subsequent car dependency for most residents, impacts on the future road network are considered critical to the assessment, which was reflected in the specific SEARs requirements received from government. Cardno's approach was to build on the previous CUDP Transport Management and Accessibility Plan, which accompanied the original development application, and where relevant update modelling and analysis to reflect key external factors which have changed since the TMAP was written in 2010.

The following changes are not attributable to the Calderwood Yield Review, but were nevertheless included in this assessment:

- The design of the Albion Park Rail bypass is consistent with the approved concept design, involving changes to the Central Interchange at Albion Park.
- The design of Tripoli Way (Albion Park bypass) is consistent with Council's current preferred configuration.
- The land use assumptions for the wider West Lake Illawarra region are based on the latest available land use information for future horizon year 2036, and consistent with the Albion Park Rail bypass EIS.

This report is structured in accordance with the *RMS Guide to Traffic Generating Developments* (2002) and SEARs requirements relating to Transport and Accessibility received from the Department of Planning & Environment on 1st February 2018. The analysis focuses on the following key areas:

- Modelling of Impacts;
- Intersection Performance Assessment and Upgrades;

- Road Performance Assessment;
- Internal Road Network and Parking;
- Pedestrian / Cyclist Connectivity;
- Public Transport Assessment; and
- Sustainable Travel Choices.

The key findings of the traffic and transport assessment are as follows:

- Based on traffic modelling and analysis undertaken by Cardno, the proposed CUDP yield increase results in increased peak hour traffic flows in the ultimate CUDP development scenario (2036). Roads impacted the most are Calderwood Road to the east of the project boundary and Escarpment Drive south of Calderwood Road.
- Based on the revised traffic modelling, the following additional road upgrades are considered necessary to mitigate the impacts of the CUDP Yield Review:
  - Widen Calderwood Road from two lanes to four lanes between Tripoli Way and the eastern boundary of the CUDP. It is recommended that the Calderwood Road upgrade is completed on the opening of the town centre (retail) and completion of the Tripoli Way bypass, which is anticipated to occur around 2026-2028.
  - Upgrade Illawarra Highway / Broughton Avenue from roundabout to signalised intersection.
  - Upgrade Calderwood Road / Tripoli Way from roundabout to signalised intersection.
  - Change the configuration of the Escarpment Drive / Marshall Mount Road intersection to give priority to Escarpment Drive traffic.
- Further upgrades are not required above and beyond the VPA agreement with Wollongong City Council in respect of the following key roads:
  - Town Centre Bypass (TCB);
  - Marshall Mount Road;
  - Yallah Road; and
  - NR1 – NR 3.
- Based on a sensitivity analysis, it was found that local employment within the CUDP has a net positive impact on vehicle kilometres travelled in the road network.
- An assessment of Sustainability Measures pertaining to transport, as identified in the TMAP, revealed that the CUDP is being delivered in accordance with the original approval. Where applicable, these measures have been reinforced or strengthened as part of the CUDP Yield Review, including:
  - Review of the pedestrian and cycling network to encourage active travel to, through and within the CUDP.
  - Refresh the short and longer term bus network planning for the CUDP, building on the Route 75 Shellharbour to Calderwood service which commenced in 2017.

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1 Introduction

1.1 Overview

Cardno has been engaged by Lendlease Communities (Calderwood) Pty Limited (Lendlease) to undertake a traffic and transport study to address the Secretary's Environmental Assessment Requirements (SEARs) and to support a proposed increased yield from approximately 4,800 dwellings to approximately 6,500 dwellings in the area known as the Calderwood Urban Development Project (CUDP).

The CUDP site is located within the Calderwood Valley in the Illawarra region. It is approximately 700 hectares in area with approximately 107 hectares of land in the Wollongong LGA and the remainder located within the Shellharbour LGA. Lendlease is the developer of the majority of the CUDP, controlling approximately 609 ha of the overall site.

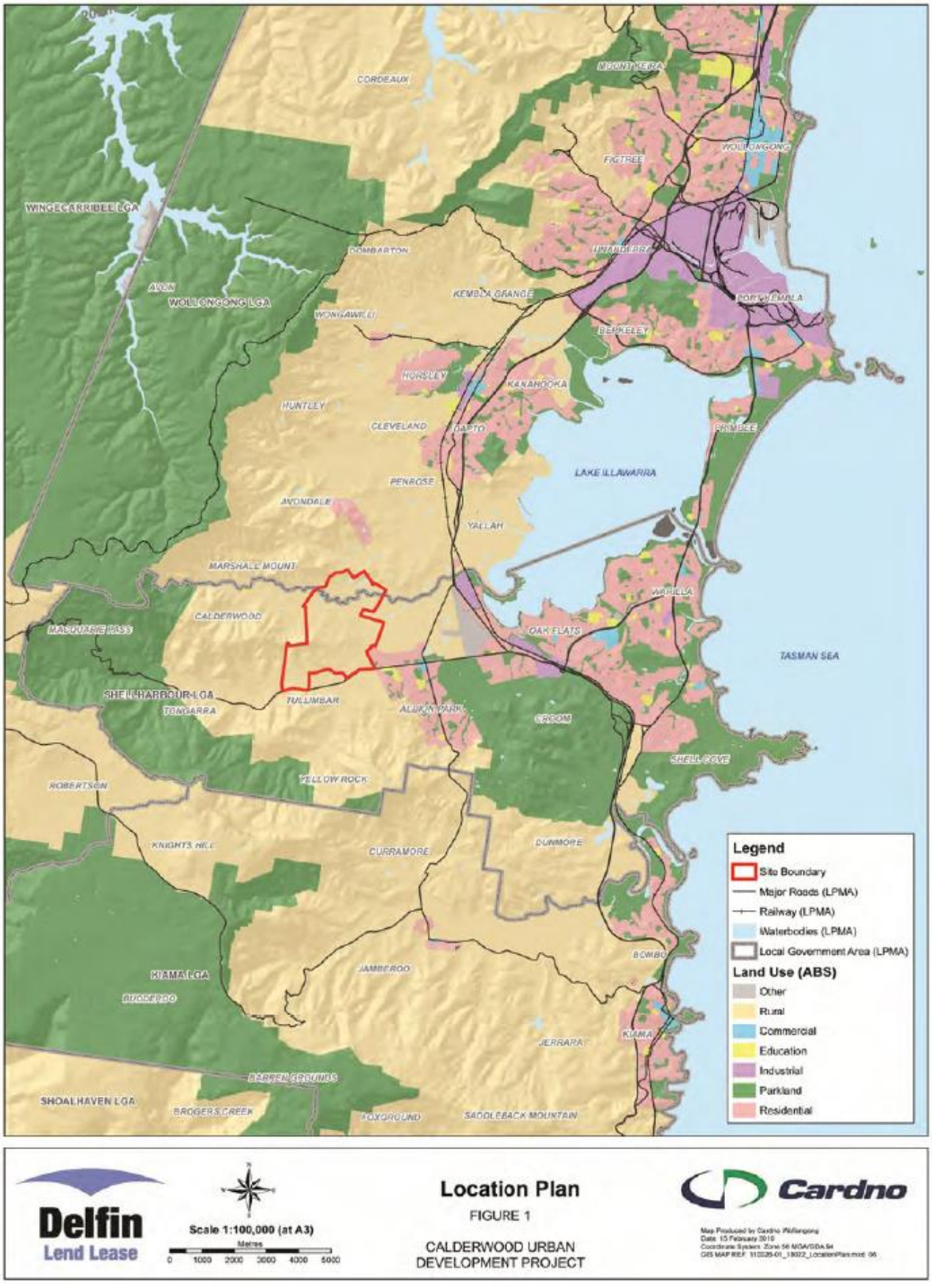


Figure 1-1 Locality Plan

Source: CUDP Concept Plan (2011).

1.2 Report structure

This traffic and transport report is a direct response to the Secretary's Environmental Assessment Requirements (SEARs) received from the Department of Planning on 1 February 2018, notably item 5 Transport and Accessibility. This traffic and transport report is structured in accordance with the *Roads and Maritime Guide to Traffic Generating Developments* (2002), set out below for transparency. **Section 4** addresses each of the SEARs requirements in turn.

- **Section 1 – Introduction**
  - Provides general overview and purpose of this traffic and transport report.
  - Describes location of the subject site with respect to Wollongong and Shellharbour LGA boundaries.
  - Provides the necessary background information about the Transport Management and Accessibility Plan (TMAP, February 2010).
  - Highlight external changes that have taken place since 2010 including the Albion Park Interchange, Tripoli Way and West Lake Illawarra land use assumptions.
- **Section 2 – Existing Conditions**
  - Describes the area of influence for the CUDP project development.
  - Provides details of existing road networks in the area of influence.
  - Provides current development status details of CUDP and other development in the surrounding region.
- **Section 3 – Summary of Approved Concept Plan and Proposed Modification**
  - Describes the approved Concept Plan.
  - Provides details of infrastructure updates for the approved Concept Plan.
  - Describes the existing residential yield and proposed changes to residential dwellings.
  - Highlights total daily and peak hour trip generation with previous yield and proposed yield.
  - Describes key land uses and desired travel lines within CUDP.
- **Section 4 – Impacts of Proposed Development**

  SEARs Part 1: Modelling of Impacts
  - Describes traffic modelling approach along with land use assumptions and modelling scenario assumptions.
  - Provides details related to traffic performance assessment criteria.
  - Describes the demographic changes and land use scenarios along with revised jobs / household data.
  - Provides detail regarding updates in road network and zones within CUDP and external sites.

  SEARs Part 2: Intersection Performance Assessment and Upgrades
  - Describes assumptions made for internal intersections in TMAP (2010)
  - Provides detail regarding proposed intersection upgrades in TMAP (2010
  - Highlights additional intersection upgrades required due to proposed increased yield in CUDP
  - Provides mitigation measures for other internal intersections.

  SEARs Part 3: Road Performance Assessment
  - Describes background review of road performance
  - Highlights additional upgrades required due to proposed increased yield in CUDP.
  - Employment sensitivity analysis.

  SEARs Part 4: Internal Road Network and Parking
  - Provides assumptions made for internal road networks and proposed internal road hierarchy in TMAP (2010).

- Describes the approved CUDP road hierarchy and design control in CUDP draft Consolidated Development Control Strategy (DCS).
- Provides updated road hierarchy plan.
- Highlight changes due to increased CUDP yield.
- Provides background information of parking provisions and controls in TMAP (2010) and CUDP draft DCS (2018).
- Highlights additional proposed parking measures.

SEARs Part 5: Pedestrian / Cyclist Connectivity

- Provides the necessary background information regarding pedestrian and cyclist provisions in TMAP (2010) and CUDP draft DCS (2018).
- Describe the adequacy of existing and planned active travel provision and integration with public transport services (previous TMAP).
- Describe the proposed potential pedestrian priority links and cycling network plans.
- Highlight safety and security measures along with local area traffic management (LATM) strategies.

SEARs Part 6: Public Transport Assessment

- Describes the relevant Integrated Public Transport Service Planning Guidelines.
- Provides the necessary background information regarding public transport provisions and formerly proposed bus network in TMAP (2010).
- Describe the adequacy of existing / planned public transport provisions in TMAP (2010).
- Provides example of different bus networks in the region.
- Describes the existing bus service in the area and potential bus network to provide services to overall CUDP.

SEARs Part 7: Sustainable Travel Choices

- Provides the necessary background information regarding measures adopted in TMAP (2010) to promote active travelling.
- Describes the updates regarding steps taken in accordance with adopted measures in TMAP (2010).
- Provides measures which promote sustainable travel choices which support the achievement of State targets.

> **Section 5 – Conclusions**

- Provides a summary of overall results of the assessment undertaken as part of this study.
- Provides detail regarding additional upgrades required due to increased yield.

1.3 Background to CUDP

Lendlease is the proponent and major land holder in the CUDP. The CUDP concept plan was approved on 8 December 2010 by the Minister for Planning, with modifications. Following approval of the Concept Plan, on 14 January 2011 Schedule 3 of State Environmental Planning Policy (Major Development) 2005 (now the State Significant Precincts SEPP) was amended to establish zoning and other planning controls for the CUDP.

The approved concept plan comprises the plans, drawings and documents cited by the proponent in its Environmental Assessment, Preferred Project Report and Statement of Commitments, subject to the modifications and further assessment requirements set out in Schedule 2 of the concept plan notice of determination. A consolidated concept plan was prepared in March 2011, which includes the Transport Management and Accessibility Plan (TMAP, 2010), found at Appendix K.

Together, the planning controls at Schedule 3 of the State Significant Precincts SEPP and the Approved Concept Plan establish the statutory planning regime for the development of the CUDP.

The approved concept plan is for the development of a total of approximately 700 hectares of land. Relevantly, Condition A1(1) of Schedule 2 of the Concept Plan determination states that approval is granted to the carrying out of development of approximately 4,800 residential dwellings and 50 hectares of mixed use employment land, open space and protection of environmentally significant lands, internal roads, service infrastructure and community facilities (including three schools).

1.3.1 Transport Management and Accessibility Plan (TMAP, 2010)

The *Transport Management and Accessibility Plan*, February 2010 (TMAP) was approved as part of the *Calderwood Urban Development Project Concept Plan* and provides the range of complementary land uses (residential, retail, employment, education and recreational) and public domain features, which were supported by a cohesive and permeable road network. Principle access was provided within the CUDP via a sub arterial north-south road, which connects to the existing road network at its southern and northernmost points. Access to the existing Calderwood Road was maintained to the east and west of the site. A further lower order network of internal CUDP roads were proposed with major collector roads capable of accommodating buses, providing a linkage between the sub-arterial road and the lowest category minor collector roads, which will provide the principal pedestrian links.

As per the TMAP, the proposed development with implementation of several sustainability measures was expected to achieve a 10% modal transfer away from private vehicles onto other transport modes.

1.3.1.1 Traffic Modelling

While preparing the TMAP, Cardno undertook traffic modelling using the WOLSH TRACKS traffic model to assess the operation of the road network during both a weekday morning and evening commuter peak period. For the base year of 2009 satisfactory operation was generally found to occur except for the Princes Highway between Illawarra Highway and Southern Freeway.

As per the TMAP, Roads and Maritime was considering to develop a F6 freeway extension between Tallawarra and Oak Flats interchanges to provide a bypass to the existing section of congested roadways and provide appropriate capacity for the needs of increasing strategic traffic and road freight movements through the area.

The TMAP adopted an agreed set of land use changes within the future year traffic modelling. The following road infrastructure upgrades were tested within assessments:

- F6 Freeway extension: Yallah to Oak Flats.
- Tripoli Way (Albion Park Bypass).
- North-facing ramps at Tallawarra interchange.

1.3.1.2 Infrastructure Upgrades

In preparing the TMAP, an iterative series of traffic modelling runs were performed to test the effects of a range of assumptions on road infrastructure provision and modal transfer targets, both with and without the CUDP development to assess road network operations.

The TMAP noted that by 2031, without the CUDP, the following infrastructure upgrades would be necessary to satisfactorily accommodate the forecast traffic demands:

- North-facing ramps at Tallawarra interchange were not required. It is noted that the future stage of the West Dapto Release Area beyond 2031 may indicate the need for the north facing ramps at Tallawarra interchange
- F6 Freeway extension: Tallawarra to Oak Flats was required to address existing deficiencies
- Tripoli Way (Albion Park Bypass) stages 1-3 were required including north and south facing ramp connections to the F6 Freeway extension (including the planned intersection upgrades along its length and at its terminal ends)
- Princes Highway between Mount Brown Road and Southern Freeway northbound offload ramp would need to be duplicated (including intersection upgrades along the duplicated section)
- Princes Highway between the Southern Freeway northbound offload ramp and Yallah Bay Road would require an additional southbound lane
- The Southern Freeway northbound off load ramp and the southbound on load ramp would need to be duplicated with associated merge diverge improvements undertaken on the Southern Freeway
- Marshall Mount Road and Yallah Road would need to be upgraded to a suitable two-lane-two-way standard.

The TMAP also identified that in 2031 with the CUDP the following infrastructure upgrades would be necessary to satisfactorily accommodate the forecast traffic demands (additional to those identified without the CUDP):

- Upgrade the priority controlled Marshal Mount Road / Yallah Road intersection to a roundabout
- Upgrade Calderwood Road to the east of the CUDP boundary to a suitable two-lane-two-way standard
- Provide the CUDP north-south sub-arterial road and intersection upgrades at its terminal ends.

1.3.1.3 Public Transport

Public transport principles and network were identified in the TMAP. The bus services and associated bus stop infrastructure was expected to provide a satisfactory level of coverage for the CUDP in accordance with the coverage targets set out in the *Outer Metropolitan Service Planning Guidelines*. A two tier bus stop hierarchy was proposed with higher order facilities (for strategic bus services including shelters/plinth to NSWTI standard) based around the sub-arterial north-south road with and the second order district services providing stops with timetable information. The proposed public transport nodes were located to maximise the opportunity for provision of higher density land uses clusters around the facilities in line with the desired urban design principles and sustainable transport objectives.

1.3.1.4 Sustainable Transport Measures

The TMAP detailed the post development mode share target was established to be a 10% shift away from car based transport following the implementation of a range of sustainability measures to increase non-car mode share. The proposed measures were as follows:

Travel Demand Measures

- Timely provision of facilities and services
- Fibre to the Home (FttH) and National Broadband Network (NBN)
- Website/community portal
- Resident kits
- Promotions
- Public transport incentives
- Land use/transport interaction including:
  - Provision of walking and cycling networks
  - A diversity of land uses and housing types across the project to accommodate a diverse population
  - Engaging and active streets that provide a positive experience for the users particularly along primary pedestrian and cycle corridors

- Crime Prevention Through Environmental Design (CPTED) principles applied to provide a greater sense of safety through passive surveillance of streets, parks and other areas of open space
- Establish a sub network of lit paths to provide for safer walking and cycling after dark
- Locate key amenities to maximise walkable access
- Holistic approach to the design of the street network, carefully balancing the needs for vehicle movement with the needs of pedestrians and cyclists.

Active Transport Principles

> Local access street design
> Pedestrian and cycle hierarchy
> Way-finding signage
> Parking strategies
> Safety elements for network
> Bicycle parking at key destinations within CUDP.

Public Transport Principles

> Bus network provision
> Bus service levels that meet and exceed NSWTI's Outer Metropolitan Service Planning Guidelines
> Early bus service provision.

1.4 External Changes Since 2010

Since the TMAP was approved in 2010, a number of external changes have occurred to land use and infrastructure planning in the West Lake Illawarra. These changes are not attributable to the proposed modification to the approved Concept Plan, but nevertheless must be accounted for in the revised traffic and transport assessment. The key external changes that were considered to be of significance are summarised below.

1.4.1 APRB Central Interchange

As per the *APRB Traffic and Transport Assessment Repor*t (Addendum, 2017), Roads and Maritime has refined a number of aspects of the project, including Albion Park Interchange, as part of the design review of Albion Park Rail Bypass (APRB).

This design refinement proposed a change of location for the northbound exit ramp. In the EIS (2015), a free-flow exit ramp was proposed to connect to the Illawarra Highway, north of Terry Street. The revised location is approximately 700 metres south and intersects with Tongarra Road via at-grade traffic lights. The northbound entry ramp and southbound exit ramp are also proposed to be located closer to the mainline, reducing the space required for the alignment. The proposed design change at Albion Park interchange is illustrated in **Figure 1-2.**

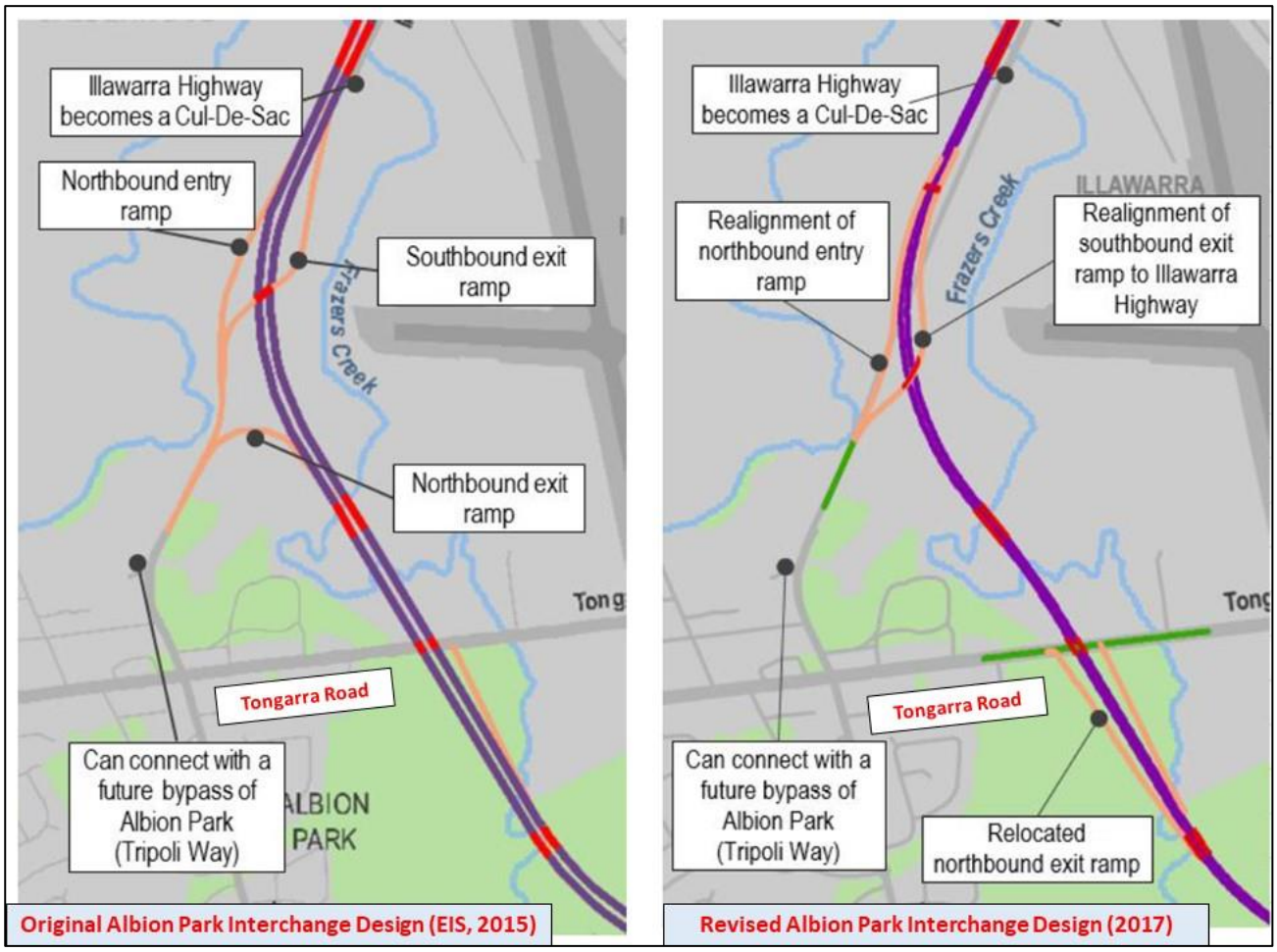


Figure 1-2 Albion Park Interchange Concept Design (Original and Revised)

Source: APRB Traffic and Transport Assessment Report (Addendum, 2017)

The revised Albion Park Rail bypass design, including the updated Albion Park interchange layout, was granted State Significant Infrastructure (SSI) approval by the Department of Planning and Environment on 30th January 2018.

1.4.2 Tripoli Way (Albion Park Bypass)

As per *APRB Traffic and Transport Assessment Report (Addendum, 2017)*, Shellharbour City Council is planning for a future bypass of the Albion Park town centre, on the existing Tripoli Way alignment extending from Terry Street in the east to Broughton Avenue in the west. According to the *APRB Traffic and Transport Assessment Report (Addendum, 2017)*, the Albion Park interchange was designed to allow connection with Tripoli Way at Terry Street. The proposed alignment of Tripoli Way, shown in **Figure 1-3**, is indicative and subject to further design development by Shellharbour Council.

Figure 1-3 Proposed Tripoli Way Alignment

Source: APRB Traffic and Transport Assessment Report (Addendum, 2017)

As per *APRB Traffic and Transport Assessment Report (Addendum, 2017),* the design of Tripoli Way was assumed to be built with two lanes in each direction from Terry Street to Broughton Avenue by 2041. Whereas, one lane in each direction was approved for Tripoli Way in the *Albion Park Rail Bypass Environmental Impact Statement (EIS, 2015).*

1.4.3 West Lake Illawarra Land Use Forecast

The *APRB Traffic and Transport Assessment Report (Addendum, 2017)* highlights that several key aspects of the TRACKS model including dwelling and employment figures in the West Lake Illawarra region were updated during the second concept design phase.

A review of the EIS residential dwellings and employment land forecasts was undertaken during *APRB Traffic and Transport Assessment Study (Addendum, 2017)* to establish land use assumptions.

The *APRB Traffic and Transport Assessment Report (Addendum, 2017)* also states that the Department of Planning and Environment (DP&E) provided Roads and Maritime with updated 2016 annual forecast rates based on dwelling numbers. Wollongong City Council supplemented these forecasts to include existing released development and to reflect Council's knowledge of development and employment area release rates in the West Lake Illawarra region. Consultation between Roads and Maritime and Wollongong City Council was undertaken to agree on the updated land use and employment forecasts for the project design horizon 2041.

The development and employment land release rates from the EIS and agreed forecasts for dwelling numbers and employment land for the West Lake Illawarra Region are outlined in **Table 1-1.** The revised and agreed numbers were adopted in the traffic assessment while preparing *APRB Traffic and Transport Assessment Study (Addendum, 2017)*.

Table 1-1 Residential and Employment Forecasts (APRB EIS & Revised)

Residential Development	2041 EIS Forecast (Released Dwellings)	2041 Revised Forecast (Released Dwellings)
West Dapto, stage 1	3,804	3,121
West Dapto, stage 2	3,396	1,962
West Dapto, stage 3	4,041	2,830
West Dapto, stage 4	3,200	470
West Dapto, stage 5	3,500	2,930
Tallawarra	1,000	600
Calderwood	7,700	5,068
Tullimbar	-	1,410
Total Residential Development	***26,641***	***18,391***
Employment Land	**2041 EIS Forecast (Developable Hectares)**	**2041 Forecast (Developable Hectares)**
Heavy Industrial	44.4	34.4
Light Industrial	134.4	131.5

Source: APRB Traffic and Transport Assessment Report (Addendum, 2017).

The revised land use forecast for West Lake Illawarra region affects both traffic generation and assignment within the study area for *APRB Traffic and Transport Assessment Study (Addendum, 2017)*.

A comparison between WOLSH land use assumptions and APRB land use assumptions was undertaken for planning horizon of future year 2036. The comparison summary is described in **Table 1-2**.

Table 1-2 Summarises the Key Differences in Forecast Residential Yield for Planning Horizon 2036

Development (Approved and Proposed)	WOLSH Land Use Assumption 2036+	APRB Land Use Assumption 2036	Difference
West Dapto, stage 1	3,121 dwellings	3,121 dwellings	0
West Dapto, stage 2	3,151 dwellings	1,712 dwellings	-1,439 dwellings
West Dapto, stage 3	4,821 dwellings	1,850 dwellings	-2,971 dwellings
West Dapto, stage 4	4,397 dwellings	470 dwellings	-3,927 dwellings
West Dapto, stage 5	4,038 dwellings	2,030 dwellings	-2,008 dwellings
Tallawarra	600 dwellings	600 dwellings	0
Tullimbar	1,410 dwellings	1,410 dwellings	0
Calderwood	7,700 dwellings	4,068 dwellings	-3,632 dwellings
TOTAL	**29,238 dwellings**	**15,261 dwellings**	**-13,977 dwellings**

Source: NSW Department of Planning - Office of Strategies and Land Release (Last Revised by Hyder Cardno Joint Venture/Roads and Maritime 17 October 2016)

2 Existing Conditions

2.1 Study Area / Area of Influence

In the TMAP, the extent of the road network was agreed with Roads and Maritime for modelling and transport assessment in context of CUDP development. The area was described as the 'area of influence' and the extent of road network is shown in **Figure 2-1.**

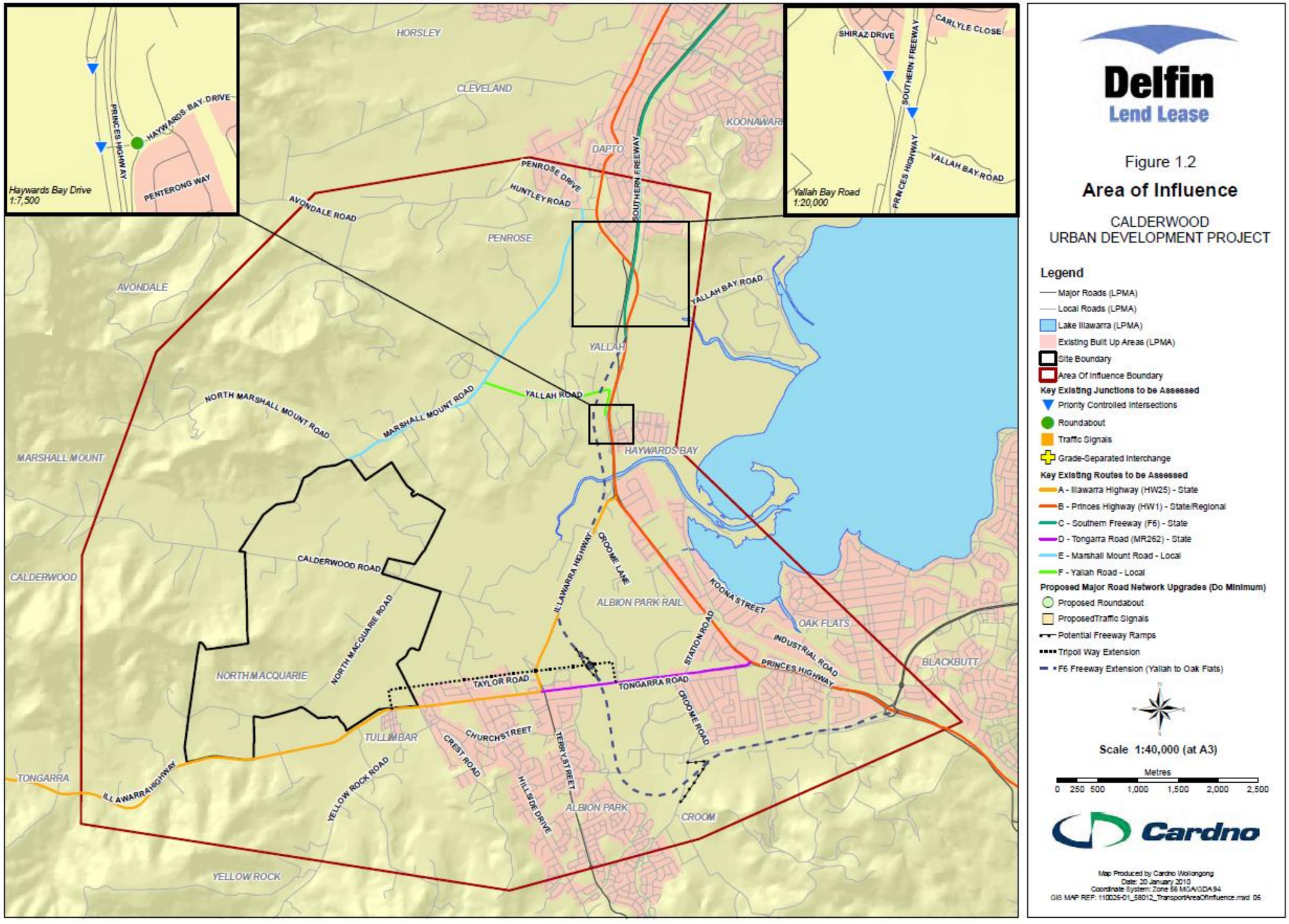


Figure 2-1 CUDP Area of Influence

Source: TMAP, 2010

2.2 Existing Road network in Calderwood

The area of influence illustrated in **Figure 2-1** was considered to describe the existing road network in the vicinity of Calderwood development. The detailed existing road network and its hierarchy is described in following sections.

2.2.1 Road Classification

There are two main systems for the classification of roads in New South Wales:

2.2.1.1 Funding Classification System

Roads and Maritime has adopted a “funding related” classification system that is primarily for administrative purposes. The key road classifications under the funding classification system are defined as:

- **State Roads** – roads performing an important state function and for which Roads and Maritime fully funds the maintenance cost. State roads are essentially arterial roads.
- **Regional Roads** – roads performing a significant regional function and for which the Roads and Maritime and Council share the costs of maintenance. Regional roads are essentially sub-arterial roads.
- **Local Roads** – roads performing a local or collector function and for which the Councils fully fund the maintenance cost. Additional funding is available from Roads and Maritime in certain circumstances on the grounds of urban amenity and road safety.

The funding road classification in CUDP area of influence is illustrated in **Figure 2-2.**

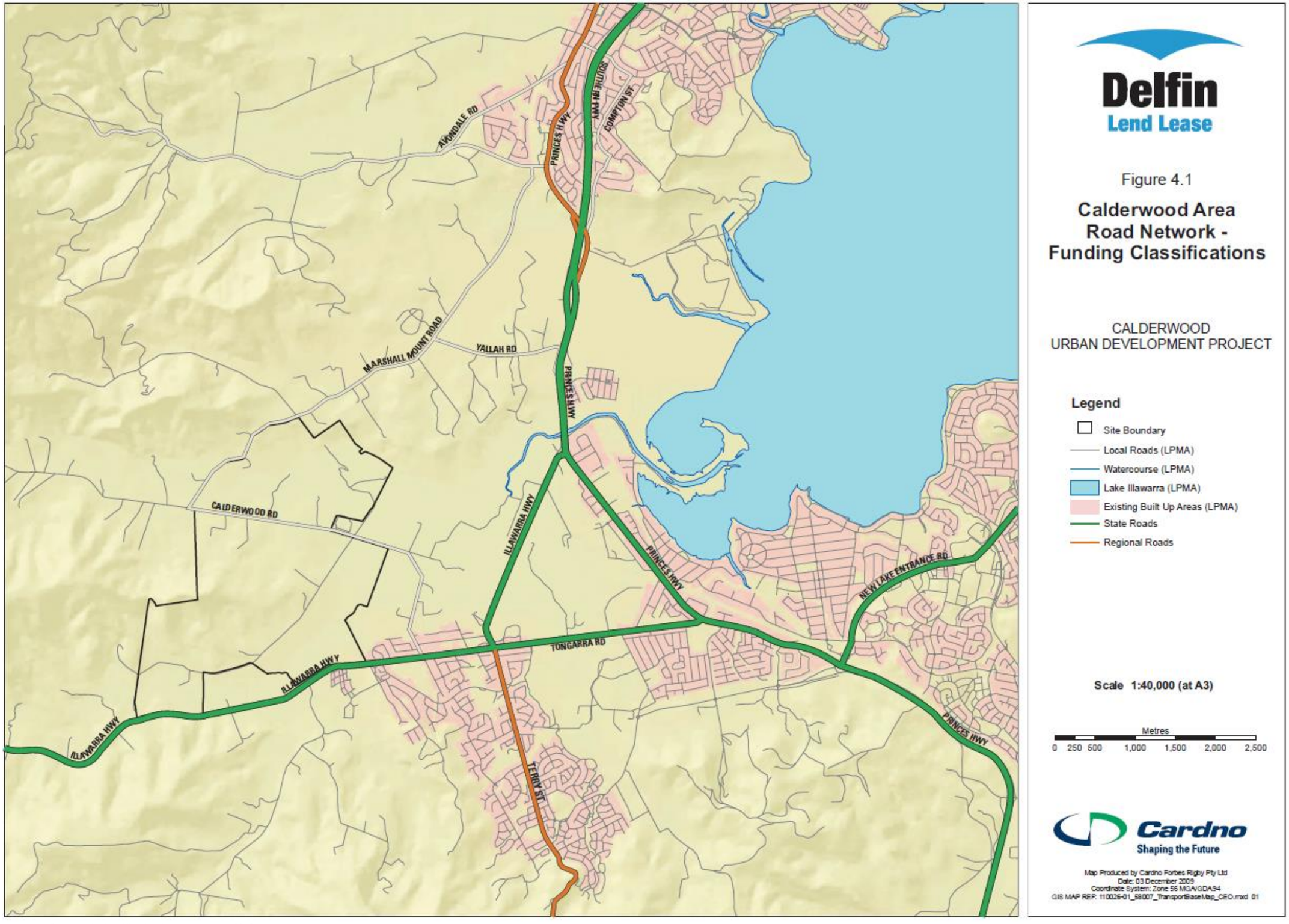


Figure 2-2 Funding Road Classification in CUDP area of influence
Source: TMAP, 2010

2.2.1.2 Functional Classification System

The functional role or performance of individual roads can be appraised according to the classification of that road within an overall road hierarchy. Changes to traffic flows on the road can then be assessed within the context of the road hierarchy. The functional hierarchy consist of arterial, sub-arterial, collector and local roads.

The functional road classification in the Calderwood area is represented in **Figure 2-3**.

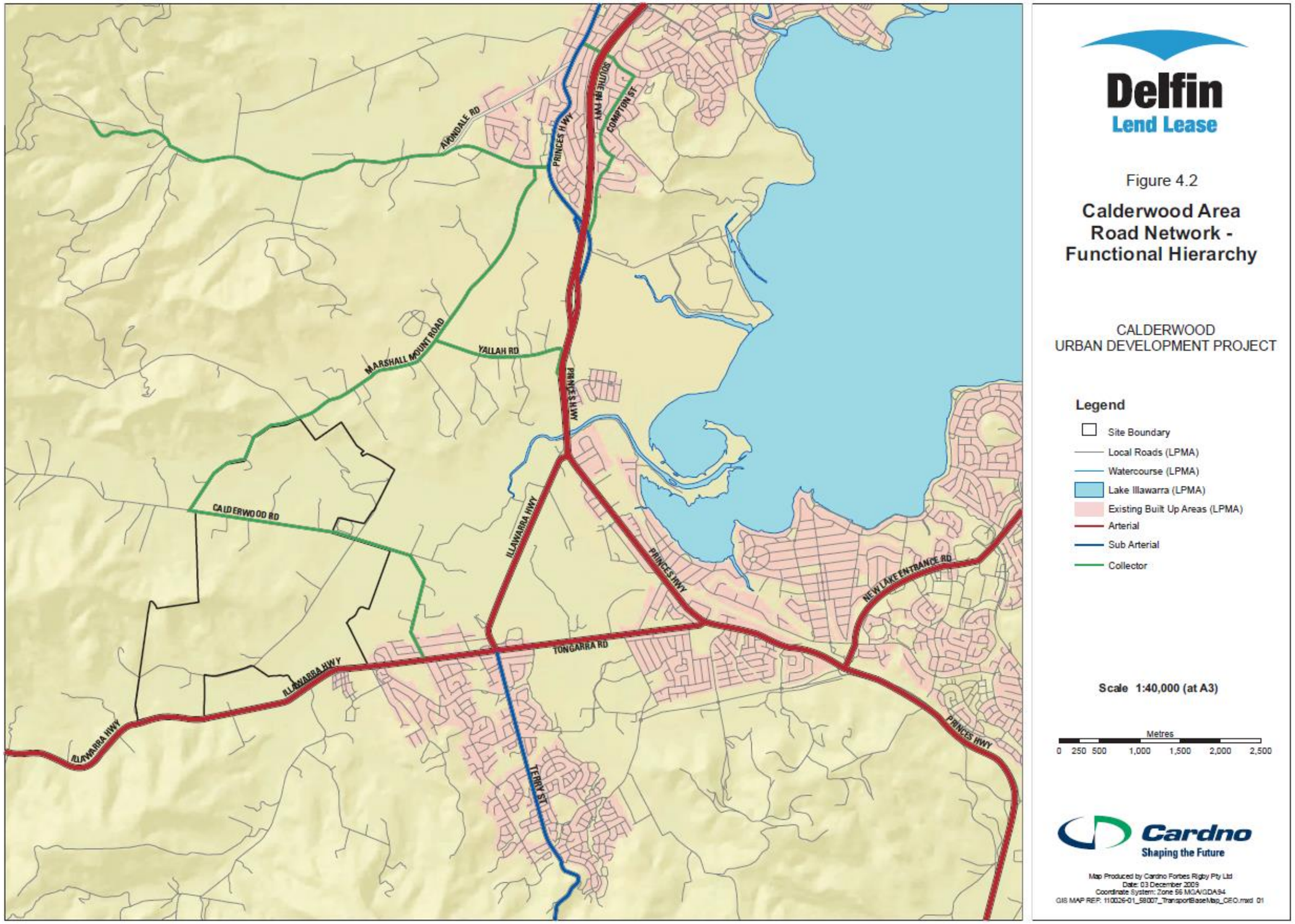


Figure 2-3 Functional Road Classification in CUDP area of influence

Source: TMAP, 2010

2.2.2 Existing Road Hierarchy in CUDP Area of Influence

As described in the TMAP, the major road network in the CUDP area of influence is comprised of the following key roads:

- Southern (F6) Freeway (now known as M1 Princes Motorway)
- Princes Highway (north of Tallawarra)
- Princes Highway (south of Tallawarra)
- Illawarra Highway
- Tongarra Road
- Huntley Road
- Marshall Mount Road
- Yallah Road
- Calderwood Road
- North Macquarie Road

A detailed description of these roads is provided in **Appendix A.**

2.3 Calderwood Urban Development Project Current Status

Lendlease has commenced the development of its component of the overall CUDP, and will continue to develop the project in stages over a period of some 15-20 years. As per current development status of different stages in CUDP, Lendlease has obtained development consents of following stages comprising around 1,300 dwellings:

- Stage 1
- Stage 2A
- Stage 3A
- Stage 2B
- Stage 2C

Lendlease has also lodged development applications for stage 3B South and stage 3C comprising nearly 650 dwellings of the overall CUDP development.

Additionally, other developers have lodged development applications for a further 824 lots (or some 850 dwellings) on land within the CUDP Concept Plan boundary that Lendlease does not own or control. **Figure 2-4** illustrates the indicative subdivision plan within the CUDP.

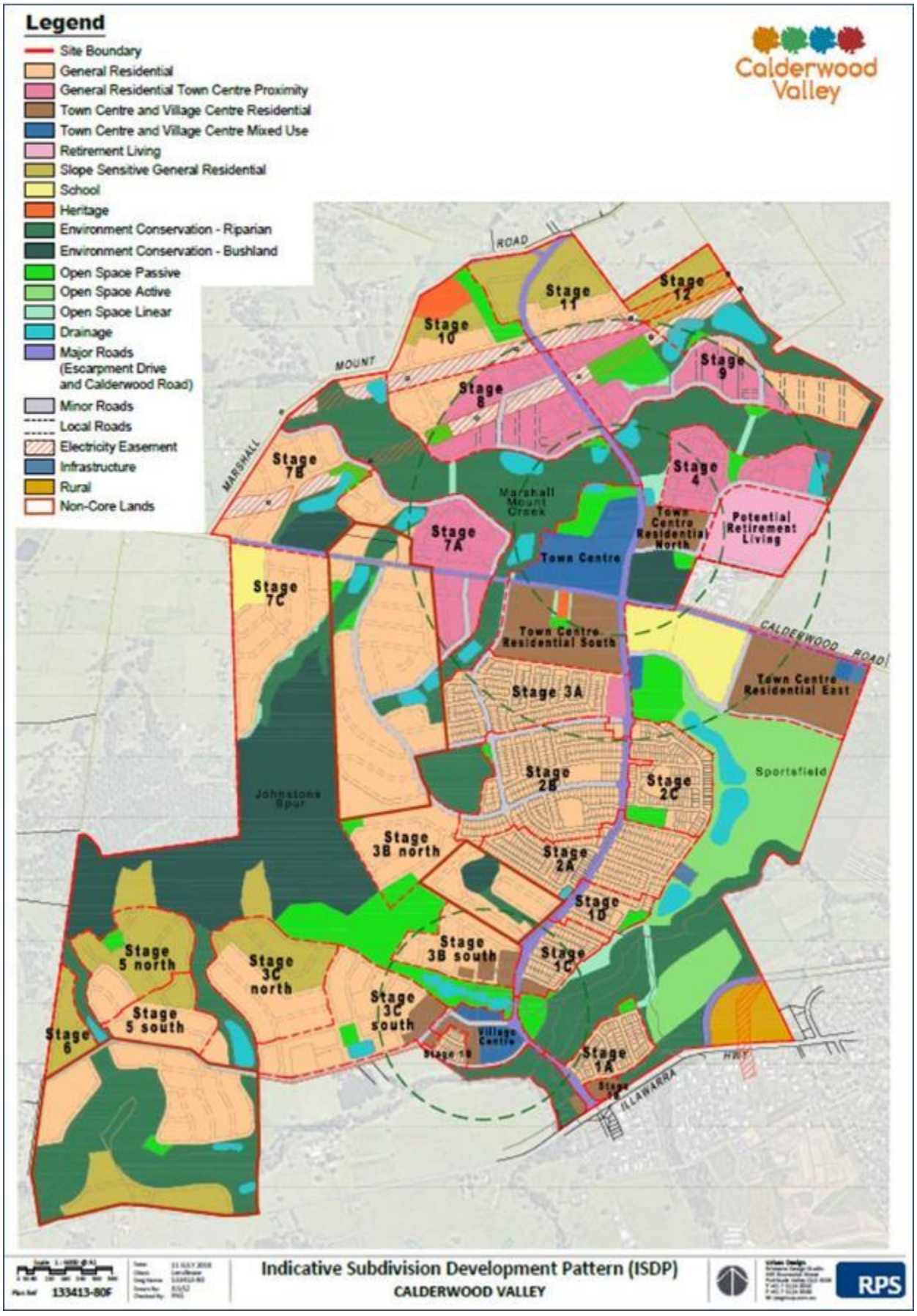


Figure 2-4 Indicative Subdivision Plan

Source: RPS (2018)

2.4 Other Development Sites

2.4.1 Tullimbar

Tullimbar is located on the southern side of the CUDP development within the foothills of the Illawarra Escarpment. The anticipated development of 1,410 residential dwellings will be completed in Tullimbar area by 2026.

Accordingly, as described in **Table 1-2,** full Tullimbar development was assumed to be completed for model development for 2036 planning horizon. The updated zoning and internal road network for developments in Tullimbar area has been incorporated in the TRACKS model.

3 Proposed Development

3.1 Existing Approval for CUDP

As described in **Section 1.3,** the CUDP Concept Plan was approved on 8 December 2010 by the Minister for Planning. A mix of residential, employment, retail, education, conservation and open space uses were subsequently approved.

In summary, the following land use development was approved on 8 December 2010, as part of the CUDP Consolidated Concept Plan (See **Figure 3-1).**

Residential

The concept plan approval was granted for approximately 4,800 dwellings

Town Centre

As per approved concept plan, the town centre will comprise a wide range of retail, commercial, business education, entertainment, civic recreation, residential, tourist and visitor accommodation and employment land uses including (in accordance with Modification C8 of the Concept Plan approval):

- A maximum of 20,000 sqm of retail floor area that may accommodate development within the following ranges:

It is important to note that although 20,000 sqm retail floor area in the town centre was approved in the CUDP Concept Plan (2010), 25,000 sqm town centre retail area was assumed for TRACKS modelling carried out as part of the TMAP (2010) study.

- Approximately 20,000 sqm of mixed use employment floor area including a wide range of commercial office, light industrial, and non-retail service/convenience tenants.
- Community facilities including a large multi-purpose community resource centre.
- Public primary school and high school.
- Residential mixed use dwellings including a range of higher density dwelling types including terraces, small lot detached homes, apartments, live work dwellings, shop top housing and retirement living (attached, semi-detached, multi dwelling housing, residential flat buildings etc.).

Village Centre

The Village Centre will include (in accordance with Modification C8 of the approved Concept Plan):

- A maximum of 5,000 sqm of retail floor area.
- Approximately 1,000 sqm of mixed use employment floor area including a range of commercial, business and light industrial uses.
- Residential mixed use dwellings including a range of higher density dwelling types including terraces, small lot detached homes, apartments, live work dwellings, shop top housing and retirement living.
- A sales and information centre.

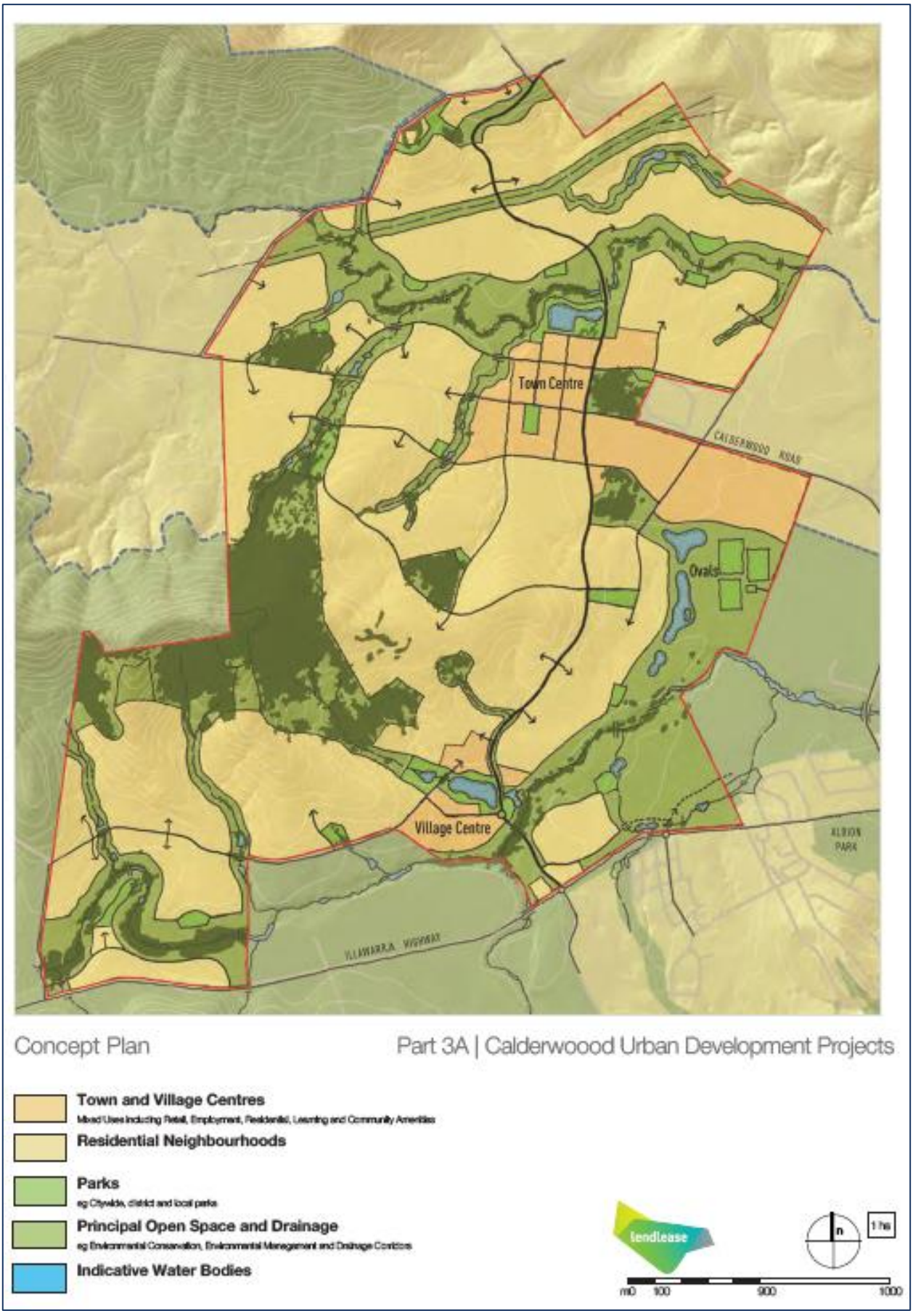


Figure 3-1 Approved Calderwood Concept Plan

Source: Consolidated Concept Plan (JBA, 2011).

3.2 Infrastructure for Existing Approval

As part of the approved TMAP, increase in traffic flow due to development of CUDP and other regional developments was forecast that formed the basis of the assessment of road infrastructure requirements through iterative series of traffic modelling runs.

Based on road network impact assessment carried out during TMAP, infrastructure (Road Link and Intersection) upgrades were proposed. The upgrades were proposed for following three scenarios:

- Upgrades Recommended to Address Existing Deficiencies (highlighted with blue).
- Upgrades Recommended to Address Future Base Deficiencies without CUDP (highlighted with green).
- Upgrades Recommended to Address Future Base Deficiencies with CUDP (highlighted with red).

The proposed infrastructure improvement for each upgrade along with location is described in **Table 3-1.**

Table 3-1 Proposed Infrastructure upgrades, (TMAP, 2010)

Upgrade Number	Location	Proposed Infrastructure Improvement
Road Link Upgrades		
Upgrade 1	F6 Extension from Tallawarra Interchange to Tripoli Way Interchange	Construction of a four-lane divided carriageway to freeway standard
Upgrade 2	F6 Extension from Tripoli Way Interchange to Croome Road Interchange	
Upgrade 3	F6 Extension from Croome Road Interchange to Oak Flats Interchange	
Upgrade 4	F6 Extension Tripoli Way North Facing Ramps	Single lane ramps on all approaches with double roundabouts and single central structure
Upgrade 5	F6 Extension Tripoli Way South Facing Ramps	
Upgrade 6	Tripoli Way extension from Illawarra Highway (East) to F6 Extension	Construct divided two way-four lane carriageway with minimum 3.5m lane widths with kerb and gutter.
Upgrade 7	Tripoli Way extension from F6 Extension to Tongarra Road	
Upgrade 8	F6 Extension Croome Road Ramps	Single lane ramps
Upgrade 9	F6 Extension Complimentary Measures	Install LATM treatments along Princes Highway between F6 extension limits
Intersection Upgrades		
Upgrade 10	Tripoli Way/Illawarra Highway	New signalised intersection
Upgrade 11	Tripoli Way/Tongarra Road	New signalised intersection
Road Link Upgrades		
Upgrade 12	F6 northbound off-ramp at Tallawarra	Provide additional off-ramp lane and associated freeway diverge upgrades
Upgrade 13	F6 southbound on-ramp at Tallawarra	Provide additional on-ramp lane and associated freeway merge upgrades
Upgrade 14	Tripoli Way from Illawarra Highway/ Broughton Avenue to Calderwood Road	Construct undivided two way-two lane carriageway with minimum 3.5m lane widths with kerb and gutter.
Upgrade 15	Tripoli Way from Calderwood Road to Illawarra Highway (East)	
Upgrade 16	Tripoli Way Complimentary Measures	Install LATM treatments along Illawarra Highway/Tongarra Road between Tripoli Way limits
Upgrade 17	Princes Highway from Mount Brown Road to Huntley Road	Provide additional northbound traffic lane

Upgrade Number	Location	Proposed Infrastructure Improvement
Upgrade 18	Princes Highway from Mount Brown Road to Huntley Road	Provide additional southbound traffic lane
Upgrade 19	Princes Hwy from Huntley Road to F6 Off-ramp	Provide additional northbound traffic lane
Upgrade 20	Princes Hwy from Huntley Road to F6 Off-ramp	Provide additional southbound traffic lane
Upgrade 21	Princes Highway from F6 Off – Yallah Bay Road	Provide additional southbound traffic lane
Upgrade 22	Marshall Mount Road from CUDP North-South Route to Yallah Road	Upgrade road to undivided two way-two lane carriageway with minimum 3.5m lane widths and sealed shoulders
Upgrade 23	Marshall Mount Road from Yallah Road to TAFE	
Upgrade 24	Marshall Mount Road from TAFE to Huntley Rd	
Upgrade 25	Yallah Road from Marshall Mount Road to Haywards Bay Drive	Upgrade road to undivided two way-two lane carriageway with minimum 3.5m lane widths and sealed shoulders
Intersection Upgrades		
Upgrade 26	Princes Highway/Huntley Road	Signalise existing priority controlled intersection
Upgrade 27	Princes Highway/F6 southbound off-ramp	Signalise existing priority controlled intersection
Upgrade 28	Princes Highway/Cormack Avenue	Signalise existing priority controlled intersection
Upgrade 29	Illawarra Highway/Broughton Avenue	Additional northern leg for Calderwood collector road
Upgrade 30	Tripoli Way/Calderwood Road	New roundabout intersection
Upgrade 31	Illawarra Highway/Terry Street	Minor signal alterations
Road Link Upgrades		
Upgrade 32	Calderwood Road from CUDP to Tripoli Way	Upgrade road to undivided two way-two lane carriageway with minimum 3.5m lane widths and sealed shoulders
Upgrade 33	North-South Route – southern section	Construct undivided two way-two lane carriageway with minimum 3.5m lane widths with kerb and gutter.
Upgrade 34	North-South Route – central section	
Upgrade 35	North-South Route – northern section	
Intersection Upgrades		
Upgrade 36	Marshall Mount Road/Yallah Road	Upgrade existing T-intersection to a roundabout
Upgrade 37	Illawarra Highway/Yellow Rock Road	Upgrade existing T-intersection to a four-arm roundabout

Figure 3-2 shows the full set of upgrade works required to address the 2031 road network deficiencies considering the full development in the region including CUDP.

It is important to note that some of the above-mentioned upgrades are completed or under-construction. For example, Escarpment Drive (upgrade 33 / 34) has been completed between Illawarra Highway and Calderwood Road. This section includes a new bridge over Macquarie Rivulet and has been designed as a flood free access route, 500 mm above the Probable Maximum Flood level (PMF).

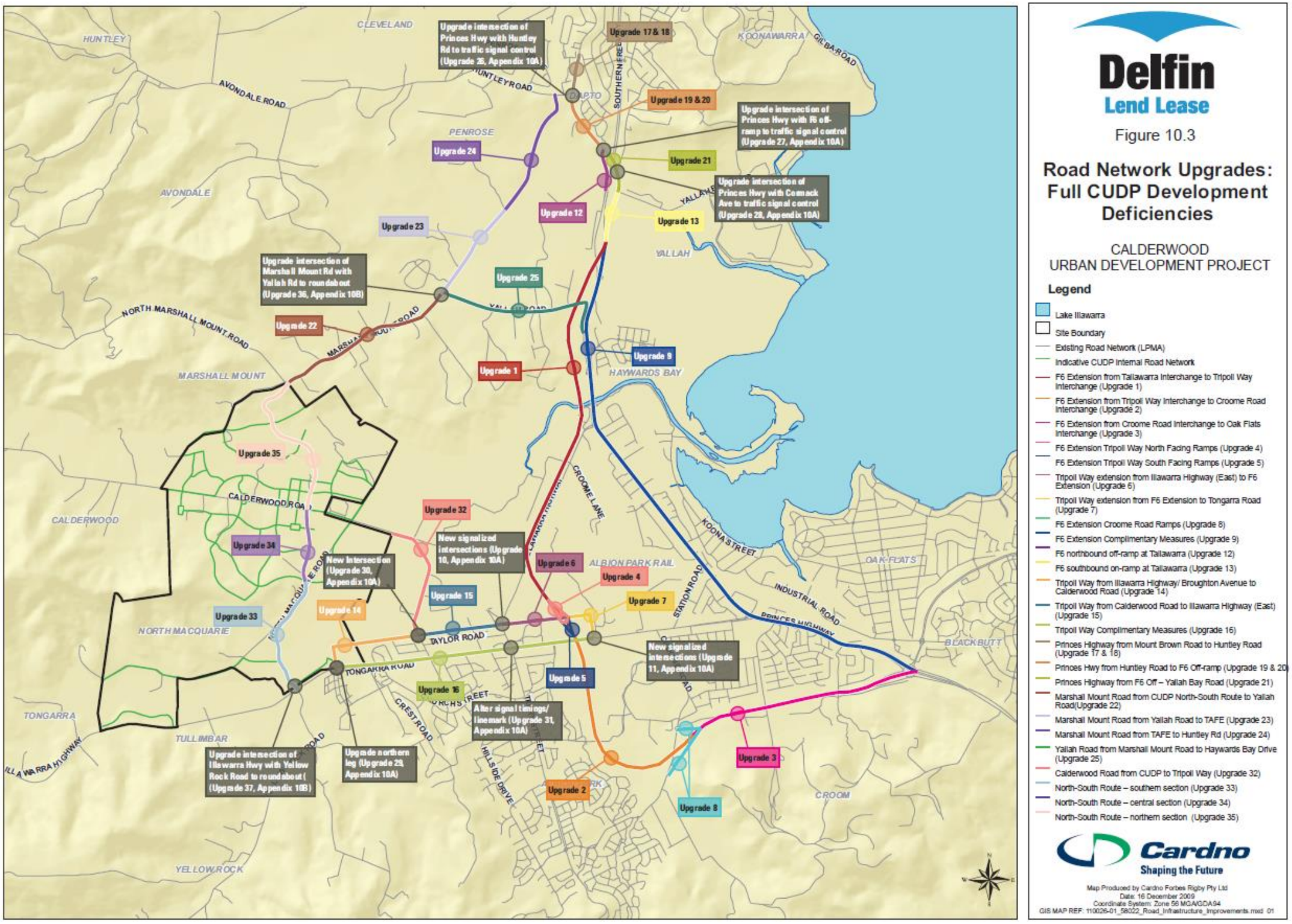


Figure 3-2 Proposed Road Network Upgrades for Future Base 2031 with CUDP
Source: TMAP, 2010

3.3 Yield Review

The proposed modification to the Approved Concept Plan seeks to increase the total provision of housing (approximate number of dwellings) within the overall CUDP to respond to market demand for the provision of smaller housing types / lot sizes at affordable price points and to ensure the efficient use of urban-zoned land within this context for the supply of housing.

It is proposed to increase the overall number of dwellings to be delivered within the existing area of land zoned R1 General Residential and B4 Mixed Use, also approved for urban development as shown on the Approved Concept Plan, from approximately 4,800 to approximately 6,500 dwellings.

It is also proposed to increase town centre retail floor area from 20,000sqm to 25,000 sqm. As highlighted in **Section 3.1**, The TRACKS model, developed as part of the TMAP (2010) study, had already assumed town centre retail area of 25,000 sqm. As such, the proposed increase in town centre retail area is not expected to have any significant impacts on performance of road network in the area of influence. Therefore, this traffic and transport report will only consider the residential yield increase (4,800 to 6,500 dwellings) to assess the impacts on existing and planned road infrastructure in the area of influence and to propose additional upgrades, if required.

There is no substantive change between the proposed modified development and that envisaged by the Approved Concept Plan in respect of:

- Approved land uses;
- Urban structure of the development;
- Road and pedestrian network within the site; and
- Public Transport Provisions.

Within the Approved Concept Plan framework, the proposed increased dwelling yield will be achieved via the delivery of a greater diversity of dwelling types and lot sizes within the R1 General Residential and B4 Mixed Use zones generally as follows:

- Within the R1 General Residential zone, additional yields will be achieved through the delivery of a more diverse range of housing types such as seniors housing and integrated housing and also by a different mix of lot sizes than was anticipated at the time of the Approved Concept Plan in 2010 (including a greater number of smaller lots) to respond to the changing and more diverse market expectations and housing affordability pressures
- Within the B4 Mixed Use zone, the number of dwellings to be provided will be increased through the provision of a combination of more shop top housing, mixed use development and stand-alone residential development.

A range of new provisions are proposed to be incorporated into the Development Control Strategy to allow for the broader range of housing typologies, lot sizes and affordable housing options that are proposed to meet current market demand.

Related changes to the Approved Concept Plan are proposed to ensure the Calderwood development meets the needs of residents, namely:

- Minor amendments and updates to road hierarchy and typology standards.
- Minor amendments to the location of preferred pedestrian and cycle pathways.

In accordance with Direction 2.3 of Illawarra-Shoalhaven Regional Plan 2015, urban design principles that support sustainability and liveability will be embedded into the design of subdivisions with diverse housing types focused around local centres along with provision of walking and cycling paths.

The proposed modified Concept Plan is shown in **Figure 3-3.**

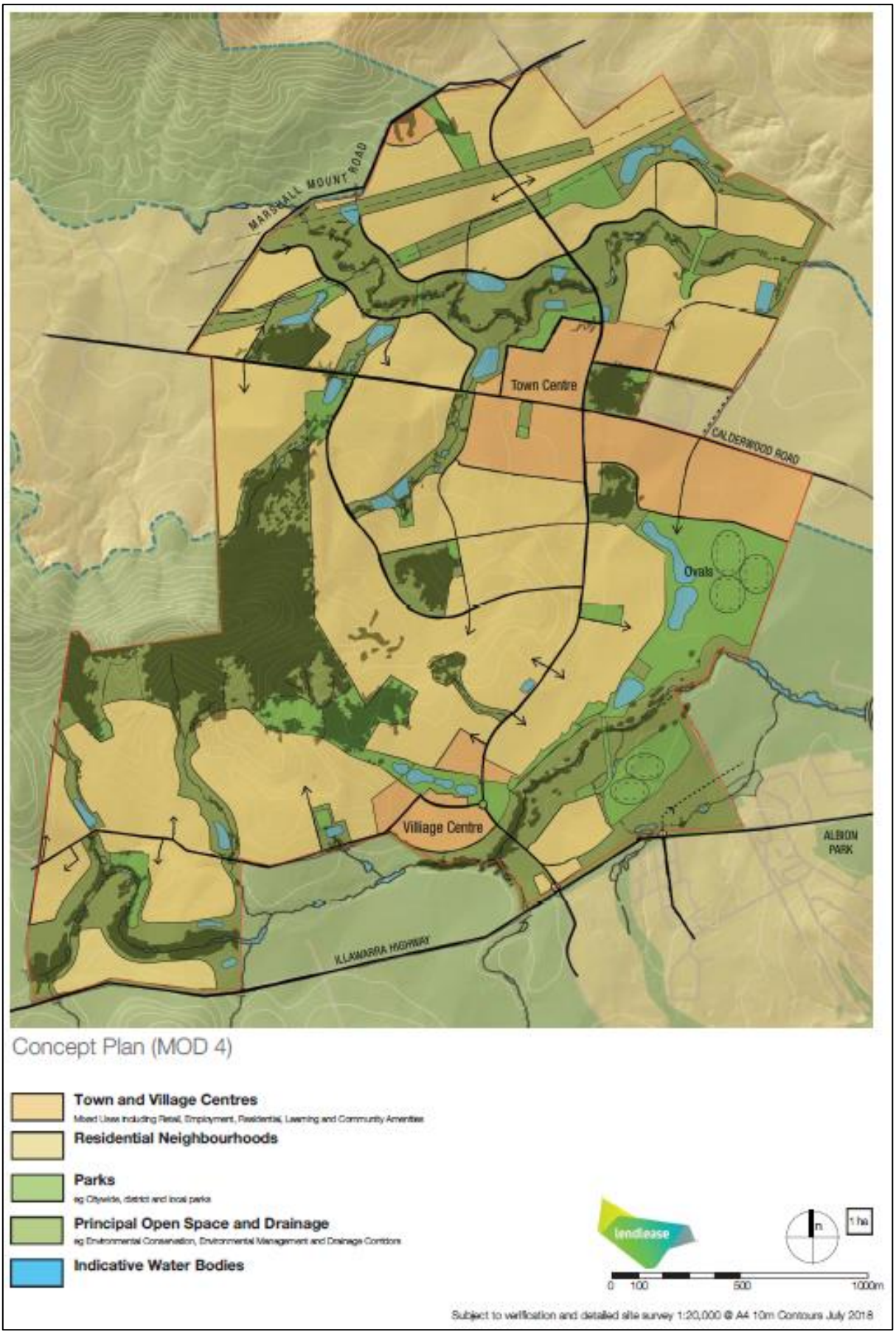


Figure 3-3 Proposed Concept Plan

Source: Lendlease

3.4 Trips Generated

Elton Consulting prepared the Calderwood Social Infrastructure Yield Review report to accompany the modification that examined household occupancy. The report concluded that the average household size across the development is 2.58 persons per dwelling. Accordingly, the average household size of 2.58 persons per dwelling has been considered for additional trip generation assessment by the proposed yield increase. The proposed additional yield of approximately 1,700 dwellings equates to an increase in population of 4,386 people.

Based on the Household Travel Survey Data (HTS)[1], the total population of the Illawarra region is 443,207, and the total number of daily trips in 2017 was 1,662,922. This equates to an average of 3.75 total trips per person per day for residents.

The resultant daily extra number of trips as a result in the Precinct may be 16,448, of which approximately 13 percent is by walking, one percent by bike and six percent public transport. This equates to 2,138 extra walking, 165 cycle trips and 987 public transport trips within the precinct per day.

It is estimated that ten percent of daily trips occur during peak hour. The total number of extra trips resulting from the additional yield is 1,645 trips; 214 walking, 17 cycling and 99 public transport trips during peak periods.

A summary of the previous and additional yield is shown in **Table 3-2.**

Table 3-2 Total Daily and Peak Hour Trips

	Walking	Cycling	Public transport	Private vehicles	Total
Estimated daily number of trips					
Previous yield	6,037	464	2,786	37,152	46,440
Additional yield	2,138	165	987	13,158	16,448
Total	8,175	629	3,773	50,310	62,888
Estimated peak hour number of trips (assumes 10% of daily volumes)					
Previous yield	604	46	279	3,715	4,644
Additional yield	214	17	99	1,316	1,645
Total	818	63	377	5,031	6,289

3.5 Land Uses and Desire Lines

Calderwood Valley is an approved master planned residential community that delivers local open space, schools and town and village centres that are largely accessible via active travel links to encourage local walking and cycling. The schools and town centres are proposed to be located along Calderwood Road, with the majority located in the centre of the CUDP. Co-located land uses are proposed to provide for the needs of residents. Open spaces and recreation parks are provided throughout, with the sports field located southeast of the town centre. There is also a potential for additional active open space to the southeast.

[1] Transport for NSW online data, accessed on 12th June 2018.

4 Impacts of Proposed Development

4.1 SEARs Part 1: Modelling of Impacts

As described in **Section 1.1**, this traffic and transport report seeks to address the SEARs relevant to traffic and transport impacts associated with the proposed CUDP yield review. The following section outlines the traffic modelling methodology that was adopted as part of this assessment.

4.1.1 Traffic Modelling Methodology

The traffic modelling approach used to assess the impacts of the proposal to the local road network is illustrated in **Figure 4-1.**

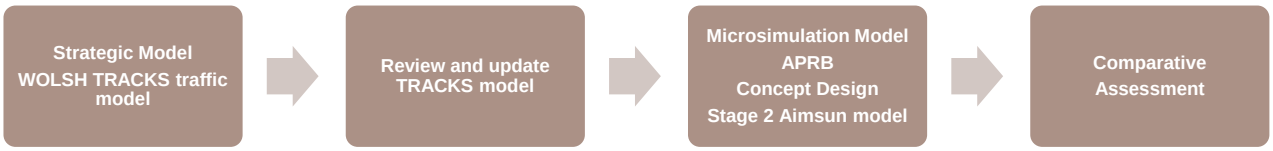


Figure 4-1 Traffic Modelling Approach

For the proposed modification, the following steps were adopted for the modelling:

- The TRACKS and Aimsun models developed as part of the Albion Park Rail Bypass post-EIS traffic modelling assessment was obtained with the permission of Roads and Maritime Services.
- Land use and road network assumptions in the TRACKS model were reviewed against current projections for the assessment year 2036.
- The following two strategic TRACKS modelling scenarios were developed:
  - Approved case of 4,800 dwellings in CUDP (2036 development scenario).
  - Proposed case of 6,500[2] dwellings in CUDP (2036 development scenario).
- Demands from the strategic TRACKS modelling scenarios were exported to the Aimsun model for the purposes of operation assessment (intersection performance etc.).
- Both TRACKS and Aimsun were used to compare the impacts of the proposed CUDP yield against the approved Concept Plan yield.

4.1.2 WOLSH and APRB Concept Design Stage 2 Traffic Models

The CUDP TMAP traffic modelling assessment was based on the WOLSH model, which is a strategic TRACKS model jointly owned and maintained by Wollongong City Council and Shellharbour Council. The yield review assessment is based on models developed by Roads and Maritime Services as part of the Albion Park Rail bypass (APRB) project.

In September 2016, Hyder-Cardno Joint Venture (HCJV) recommenced the concept design for the APRB, post exhibition of the Environment Impact Study (EIS). The strategic model used during the APRB assessment was a cordoned or 'windowed' sub area of the WOLSH model. When the WOLSH model was analysed by the HCJV team, it was found to contain erroneous land use forecasts for a notional year 2036+, which was subsequently revealed to represent the year 2067 in respect of development yield for the major sites in the West Lake Illawarra region.

In late 2016 a number of meetings were held with Wollongong City Council, Roads and Maritime, HCJV and the NSW Department of Planning and Environment (DPE), resulting in some major revisions to the TRACKS model including revised staging of development for the region (See **Section 1.4.3**). These agreed

[2] The modelling for this assessment assumed a slightly higher proposed yield in CUDP of 6,600 dwellings, therefore the results can be considered conservative.

assumptions were carried through all strategic and microsimulation modelling undertaken during the APRB post-EIS traffic modelling assessment. The APRB post-EIS study, known as a preferred infrastructure report, was completed and was approved in January 2018.

The updated TRACKS model and calibrated APRB Aimsun model have both been made available to Lendlease for the purpose of this study. The APRB models are considered the most up to date and accurate basis for future year assessment in the West Lake Illawarra region.

4.1.3 Road Network Assumptions

For this study Cardno used the APRB Concept Design Stage 2 Aimsun model as a starting point. In 2016 Roads and Maritime and Wollongong City Council formed agreement on key network geometry items which may affect major traffic flows and assignment in the APRB model. These network geometry changes included works not listed in the scope of the APRB project but rather were identified as 'most likely' changes for the 2041 road network.

These network geometry items were incorporated into the APRB TRACKS and Aimsun models for the purposes of the traffic assessment. The network geometry assumed for the CUDP Yield Review 2036 modelling horizon was consistent with the 2041 models used for APRB, unless stated otherwise in this traffic and transport report.

As part of the yield review assessment, further refinements were made to the model network geometry and TRACKS model zoning system to ensure the most accurate modelling results possible. These refinements can be summarised as follows:

- Cardno increased the number of zones in the CUDP to better match the development stages as indicated on the latest yield analysis plans provided by Lendlease.
- Minor changes to the CUDP internal road network were made to reflect infrastructure on the ground and latest road planning information, as advised by Lendlease.
- The Tullimbar zonal system, road network, traffic generation and assignment were incorporated in the model, based on latest available information. This was considered important as it directly impacted on road and intersection performance on Illawarra Highway.

4.1.4 Land Use Assumptions

Table 4-1 summarises the land use modelling scenarios for the traffic impact assessment. The approved modelling scenario was comparatively assessed to the proposed modelling scenario, to determine the traffic impacts of the proposed modification.

Table 4-1 Summary of Calderwood Valley land use for each scenario

Land Use	TMAP (2010)	Proposed Yield Review (2018)
Residential Dwellings[1]	4,800 Dwellings	6,500 Dwellings
Retail GFA[2]	30,000 sqm	30,000 sqm
Commercial GFA[3]	21,000 sqm	21,000 sqm
Schools	Total school population approx. 4,600 students	Total school population approx. 4,600 students

1. The 4,800 scenario Commercial jobs include 1,343 jobs categorised as Mining, Manufacturing and Utilities jobs.
2. The retail job rate was assumed to be 1 job per 33.33 sqm.
3. The commercial job rate was assumed to be 1 job per 50.00 sqm.
4. The schools job rate was assumed to be 1 job per 12 students.
5. Jobs as indicated by Lendlease, inclusive of teaching, administration, grounds, and maintenance.

4.1.5 Operational Modelling Assessment

4.1.5.1 Road Performance Criteria

For the purposes of determining mid-block road capacity, traffic performance was assessed using criteria contained within Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis. **Figure 4-2** illustrates theoretical road performance under different flow and speed conditions, also referred to as Service Flow Rates. Austroads describes Service Flow Rate as the maximum hourly rate at which vehicles can reasonably be expected to traverse a point under the prevailing roadway, traffic and control conditions while maintaining a designated level of service. They indicate the vehicle capacity for each level of service and are used to determine the level of service corresponding to actual traffic volumes.

For example, a traffic flow of 1,450 passenger cars per lane travelling at 110 km/h results in LoS C, however the same volume travelling at an average speed of 60km/h results in LoS E. These thresholds were used to assess level of service as part of the Calderwood yield review.

At each level of service, the service flow rate is defined as the maximum for that level. Service flow rates are discrete values, whereas the level of service represents a range of conditions. Service flow rates therefore effectively define the flow boundaries between the levels of service.

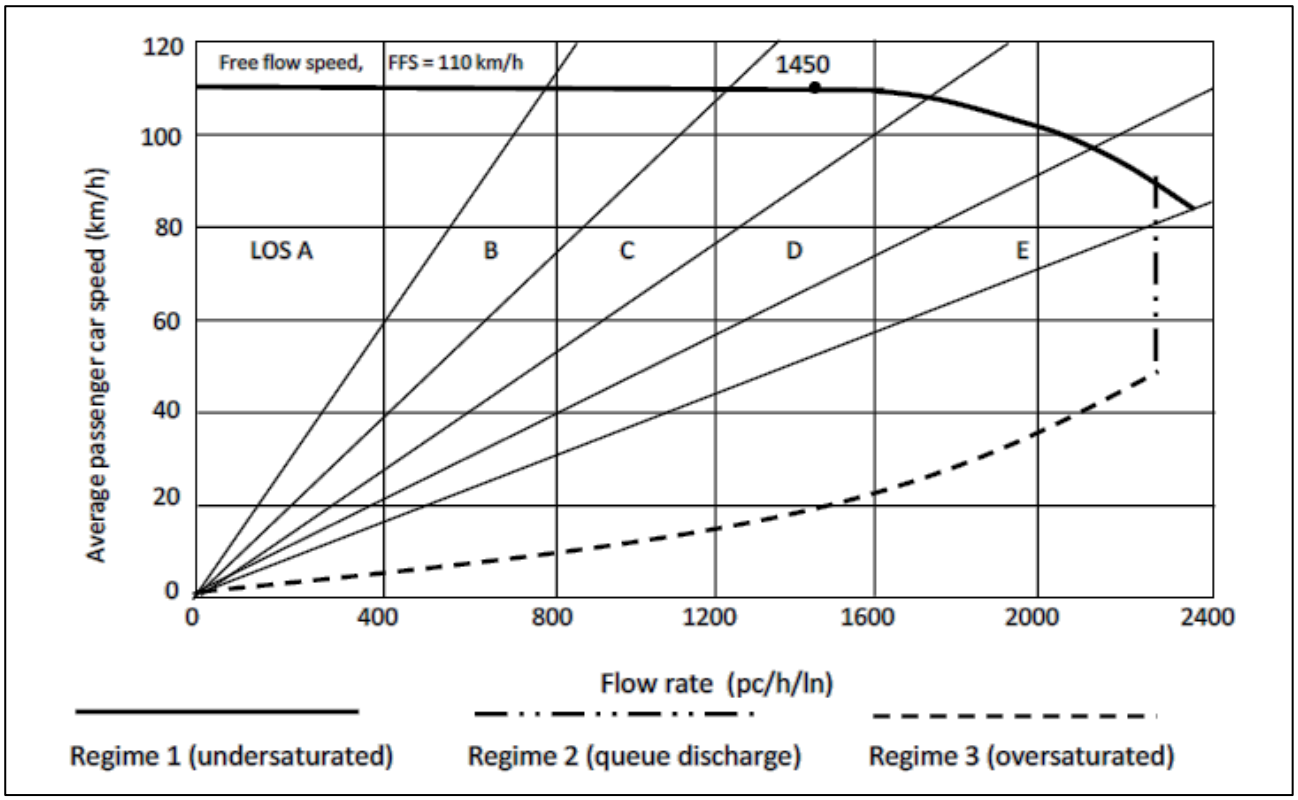


Figure 4-2 Service Flow Rates Definition of the Flow Boundaries between Levels of Service

Source: Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis

Table 4-2 provides definitions for the Service Flow Rate and LoS classifications 'A' to 'F'.

Table 4-2 Level of Service and Service Flows Rates

LoS	Description	Speed and Flow Ranges *
A	A condition of free-flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.	60km/h - 0-400 veh/h/ln 90km/h - 0-600 veh/h/ln 110km/h - 0-800 veh/h/ln
B	In the zone of stable flow where drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is a little less than with level of service A.	60km/h - 400-650 veh/h/ln 90km/h – 600-900 veh/h/ln 110km/h -800-1,200 veh/h/ln
C	Also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.	60km/h - 650-850 veh/h/ln 90km/h – 900-1,400 veh/h/ln 110km/h -1,200-1,650 veh/h/ln
D	Close to the limit of stable flow and approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.	60km/h – 850 – 1,250 veh/h/ln 90km/h –1,400 – 1,800 veh/h/ln 110km/h -1,650 – 1,900 veh/h/ln
E	Traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic	60km/h –1,250 – 1,650 veh/h/ln 90km/h – 1,800 – 2,000 veh/h/ln

LoS	Description	Speed and Flow Ranges *
	stream. Flow is unstable and minor disturbances within the traffic stream will cause breakdown.	110km/h – 1,900 – 2,100 veh/h/ln
F	In the zone of forced flow, where the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow breakdown occurs, and queuing and delays result.	60km/h – above1,650 veh/h/ln 90km/h – above 2,000 veh/h/ln 110km/h – above 2,100 veh/h/ln

Source: Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis

** Approximate range*

4.1.5.2 Intersection Performance Criteria

When assessing individual intersection performance, Cardno utilised both Aimsun and SIDRA to analyse Average Vehicle Delay (AVD) and Level of Service (LoS).

The intersection performance criteria is based on the Roads and Maritime Traffic Modelling Guidelines (2013). The capacity of a road network can be largely determined by the capacity of the controlling intersections. The key indicator of intersection performance Level of Service (LoS) is delay, where results are placed on a continuum from 'A' to 'F' as shown in **Table 4-3**.

Table 4-3 Level of Service Criteria

Level of Service	Average Delay per Vehicle (seconds)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays	At capacity, requires other control mode
F	>70	Unsatisfactory and requires additional capacity	Unsatisfactory and requires additional capacity

**Source: RMS Traffic Modelling Guidelines (2013)*

Roads and Maritime guidelines state that for roundabouts and priority control intersections a Level of Service (LoS) assessment should be reported based on the worst performing movement of the intersection. For traffic signals, the average movement delay and corresponding Level of Service (LOS) over all movements should be determined and reported. **Section 4.2** of this traffic and transport report addresses the intersection performance with proposed yield increase and required upgrades.

4.1.6 Conclusions

- For the CUDP Yield Review assessment, Cardno used the latest available TRACKS and Aimsun models for the West Lake Illawarra region, as supplied by the RMS APRB project team.
- Updates were made to the model zonal system and network geometry to reflect latest available information and ensure accurate modelling results.
- The comparative assessment used a 2036 modelling horizon.
- For the purposes of the comparative modelling assessment, the only difference between the approved Concept Plan scenario and the proposed CUDP yield scenario was an increase of 1,700 dwellings in the CUDP.

4.2 SEARs Part 2: Intersection Performance Assessment and Upgrades

4.2.1 Background Review of Assumptions / Description for CUDP Internal Intersection

As per Appendix 5E "Future CUDP Road Network" of TMAP (2010), a series of assumptions were made, based upon the CUDP internal road network hierarchy, as to the intersection control strategy to be adopted within the precinct for modelling purposes. These assumptions are as follows:

- Town centre sub arterial road – major collector road intersections – due to the concentration of activities within the town centre (housing, retail, commercial) and the consequent focus of traffic, pedestrian and bus movements it is considered that traffic signal controlled four way intersections would be appropriate intersection controls
- Intersections of sub-arterial road and major collector roads - where four arm intersections are proposed as part of the road hierarchy plan these should be controlled by roundabout for speed reduction and operational reasons
- Intersections of sub-arterial road and minor collector roads - where four arm intersections are proposed as part of the road hierarchy plan these should be controlled by roundabout for speed reduction and operational reasons and three arm intersections priority control considered adequate on capacity grounds
- Intersections of major collector roads and minor collector roads - where four arm intersections are proposed as part of the road hierarchy plan these should be controlled by roundabout for three arm intersections priority control considered adequate on capacity grounds
- A three arm roundabout is assessed such that the major collector road forming the CUDP north-western boundary can tie into the north-south sub arterial/Marshall Mount Road.

4.2.2 Background Review of Intersection Assessment and Upgrades

An assessment of Intersections within the area of influence was carried out as part of the TMAP. As described in **Section 3.2** and highlighted in **Table 4-2**, intersections improvements were also proposed along with road link upgrades to ensure satisfactory performance of overall transport network in future years. The intersection upgrades were proposed to accommodate anticipated traffic with and without CUDP yield.

The intersection upgrades were proposed for following scenarios and are shown in **Table 4-4** and illustrated in **Figure 4-3** also**.**

- Upgrades Recommended to Address Existing (2010) Deficiencies (highlighted with blue)
- Upgrades Recommended to Address Future Base Deficiencies without CUDP (highlighted with green)
- Upgrades Recommended to Address Future Base Deficiencies with CUDP (highlighted with red).

Table 4-4 Proposed Intersection upgrades (TMAP, 2010)

Upgrade Number	Location	Proposed Infrastructure Improvement	Funding Mechanism
Upgrade 10	Tripoli Way/Illawarra Highway	New signalised intersection	VPA
Upgrade 11	Tripoli Way/Tongarra Road	New signalised intersection	VPA
Upgrade 26	Princes Highway/Huntley Road	Signalise existing priority controlled intersection	VPA
Upgrade 27	Princes Highway/F6 southbound off-ramp	Signalise existing priority controlled intersection	VPA
Upgrade 28	Princes Highway/Cormack Avenue	Signalise existing priority controlled intersection	VPA
Upgrade 29	Illawarra Highway/Broughton Avenue	Additional northern leg for Calderwood collector road	VPA
Upgrade 30	Tripoli Way/Calderwood Road	New roundabout intersection	VPA
Upgrade 31	Illawarra Highway/Terry Street	Minor signal alterations	N/A
Upgrade 36	Marshall Mount Road/Yallah Road	Upgrade existing T-intersection to a roundabout	VPA
Upgrade 37	Illawarra Highway/Yellow Rock Road	Upgrade existing T-intersection to a four-arm roundabout	WIK

It is important to note that some of the above-mentioned upgrades are completed or under-construction. For example, Illawarra Highway / Yellow Rock Road intersection has been upgraded to four leg roundabout intersection.

4.2.3 Additional Intersection Upgrades for Increased Yield

4.2.3.1 Additional Intersection Upgrades w.r.t Proposed Intersection Upgrades in TMAP (2010)

As part of this study, assessment was again undertaken for all the intersection for which upgrades were proposed in TMAP (2010) for future year 2031. The basic aim of the assessment was to analyse the impact of proposed increase in CUDP yield on performance of intersections for future year 2036.

Additional intersection improvements / upgrades recommended to address impacts due to proposed increase in CUDP yield are detailed in **Table 4-5.**

Table 4-5 Proposed Intersection upgrades due to increased CUDP yield

Upgrade Number	Location	Proposed Improvements (TMAP, 2010)	Additional Improvements due to Increased CUDP yield
Upgrade 26	Princes Highway / Huntley Road	Signalise existing priority controlled intersection	No additional change required
Upgrade 27	Princes Highway / M1 southbound off-ramp	Signalise existing priority controlled intersection	No additional change required
Upgrade 28	Princes Highway / Cormack Avenue	Signalise existing priority controlled intersection	No additional change required
Upgrade 29	Illawarra Highway / Broughton Avenue	Additional northern leg for Calderwood collector road	Upgrade to signals from roundabout required
Upgrade 30	Tripoli Way / Calderwood Road	New roundabout intersection	Upgrade to signals from roundabout required
Upgrade 31	Illawarra Highway / Terry Street	Minor signal alterations	No additional change required
Upgrade 36	Marshall Mount Road / Yallah Road	Upgrade existing T-intersection to a roundabout	No additional change required
Upgrade 37	Illawarra Highway / Yellow Rock Road	Upgrade existing T-intersection to a four-arm roundabout	No additional change required

It is evident from **Table 4-5** that additional improvements will be required to already proposed intersection upgrade 29 and 30 to accommodate increased CUDP yield in future year 2036. In both cases, it will be necessary to upgrade roundabout to signalised intersections. The proposed additional improvements are illustrated in **Figure 4-3** and **Figure 4-4** for upgrade 29 and 30 respectively.

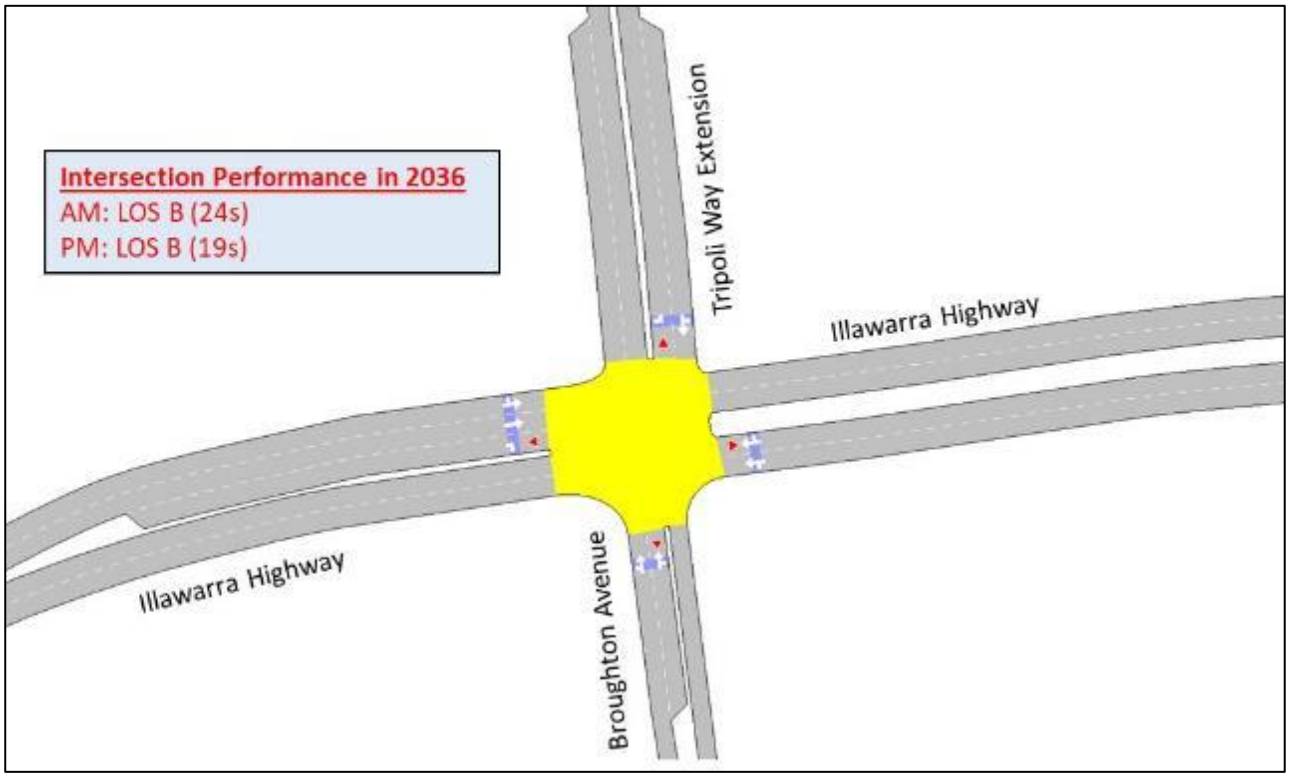


Figure 4-3 Upgrade 29 at Illawarra Highway / Broughton Avenue Intersection from roundabout to signals

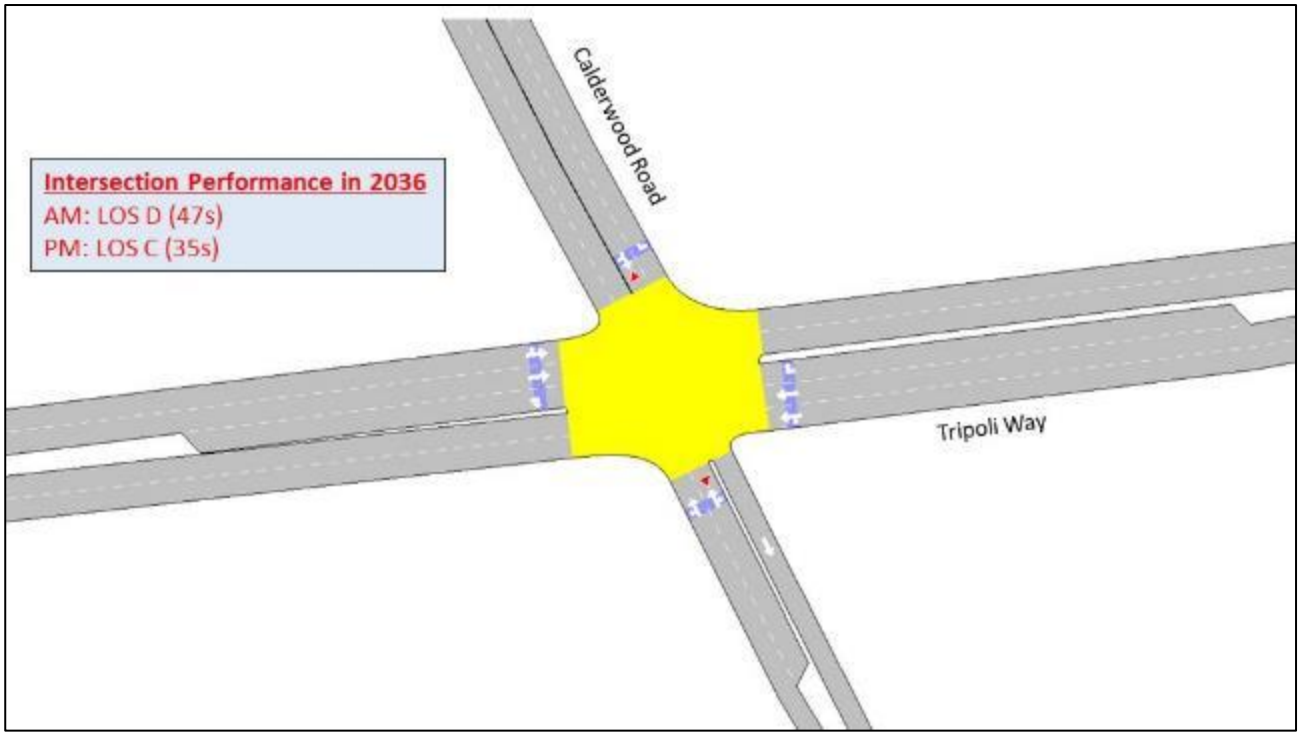


Figure 4-4 Upgrade 30 at Tripoli Way / Calderwood Road intersection from roundabout to signals

The layout and performance of other intersections with the proposed increase in the CUDP yield are illustrated in **Appendix B.**

4.2.3.2 Assessment of Other Key Intersections

In addition to intersection assessment described in **Section 4.2.3.1**, the following key intersections were also assessed to check performance in future year 2036:

- Escarpment Drive / Calderwood Road
- Marshall Mount Road / North Marshall Mount Road / Escarpment Drive.

4.2.3.2.1 Escarpment Drive / Calderwood Road Intersection

A signalised intersection was assumed at Escarpment Drive / Calderwood Road Intersection for modelling of 2031 scenario during TMAP (2010) study.

As per the future year 2036 modelling results with increased CUDP yield, the Escarpment Drive / Calderwood Road Intersection will be performing at satisfactory LoS of “B” in both AM and PM peak periods (See **Figure 4-5**). Thus, no change in intersection control / geometry is required due to increased CUDP yield.

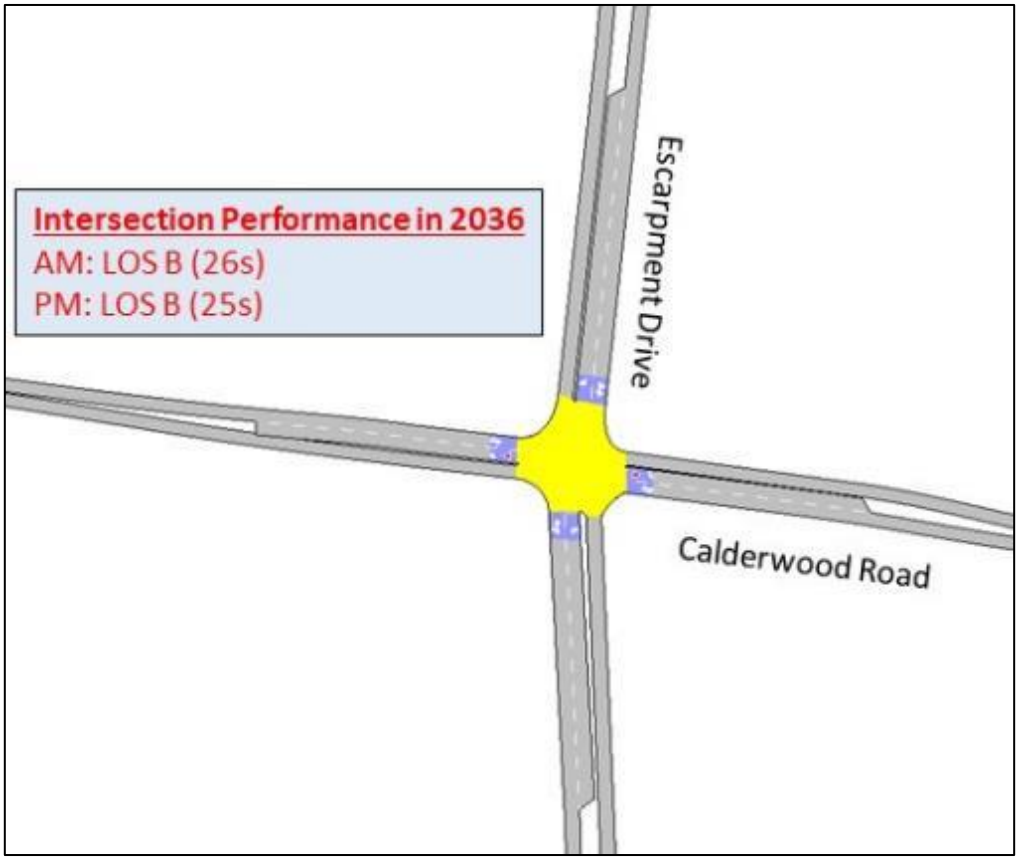


Figure 4-5 Assessment of Calderwood Road / Escarpment Drive Intersection

4.2.3.2.2 Marshall Mount Road / North Marshall Mount Road / Escarpment Drive Intersection

The Marshall Mount Road / Escarpment Drive intersection was assumed to be a three leg roundabout and Marshall Mount Road / North Marshall Mount Road intersection was assumed to be a three leg priority control intersection in TMAP (2010) modelling.

a. Option A

As shown in **Figure 4-6**, based on modelling results, the four-leg roundabout intersection will be performing at LoS "A" in both AM and PM peak in future year 2036. The indicative intersection layout is illustrated in **Figure 4-7.**

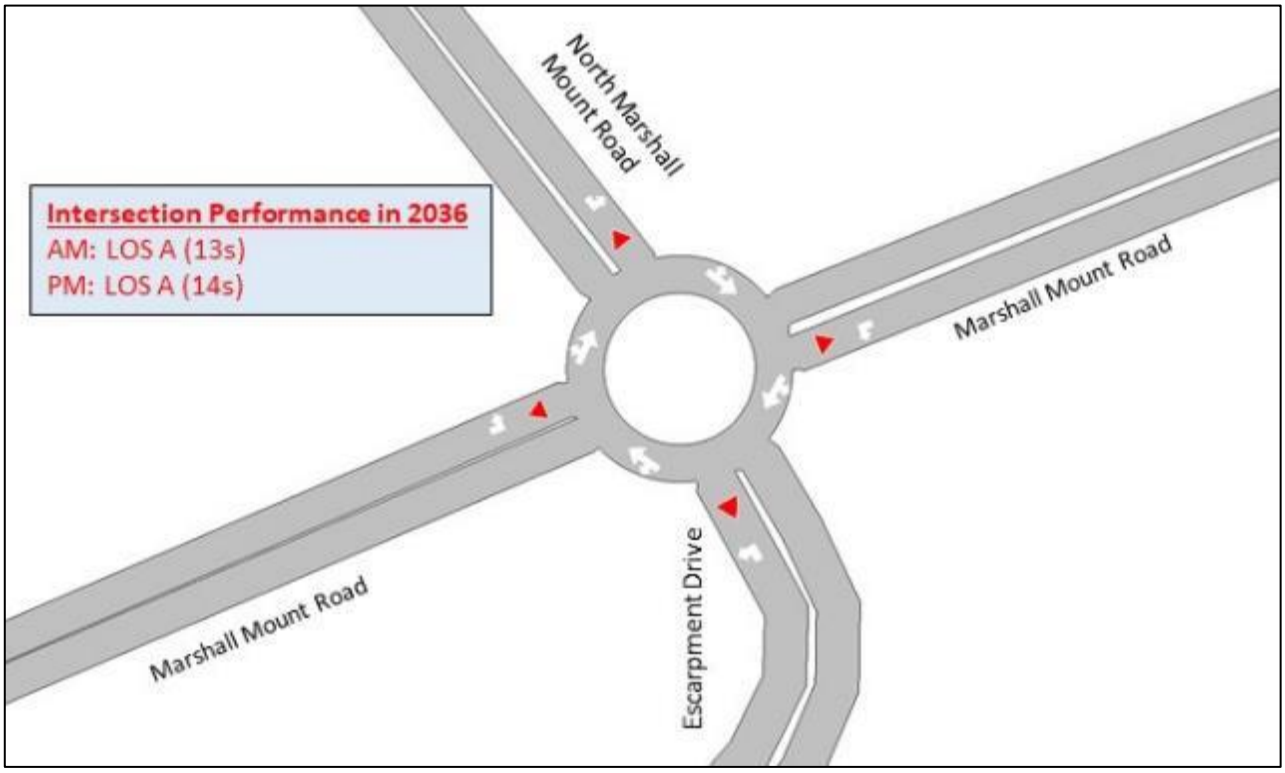


Figure 4-6 Assessment of Marshall Mount Road / North Marshall Mount Road / Escarpment Drive Intersection

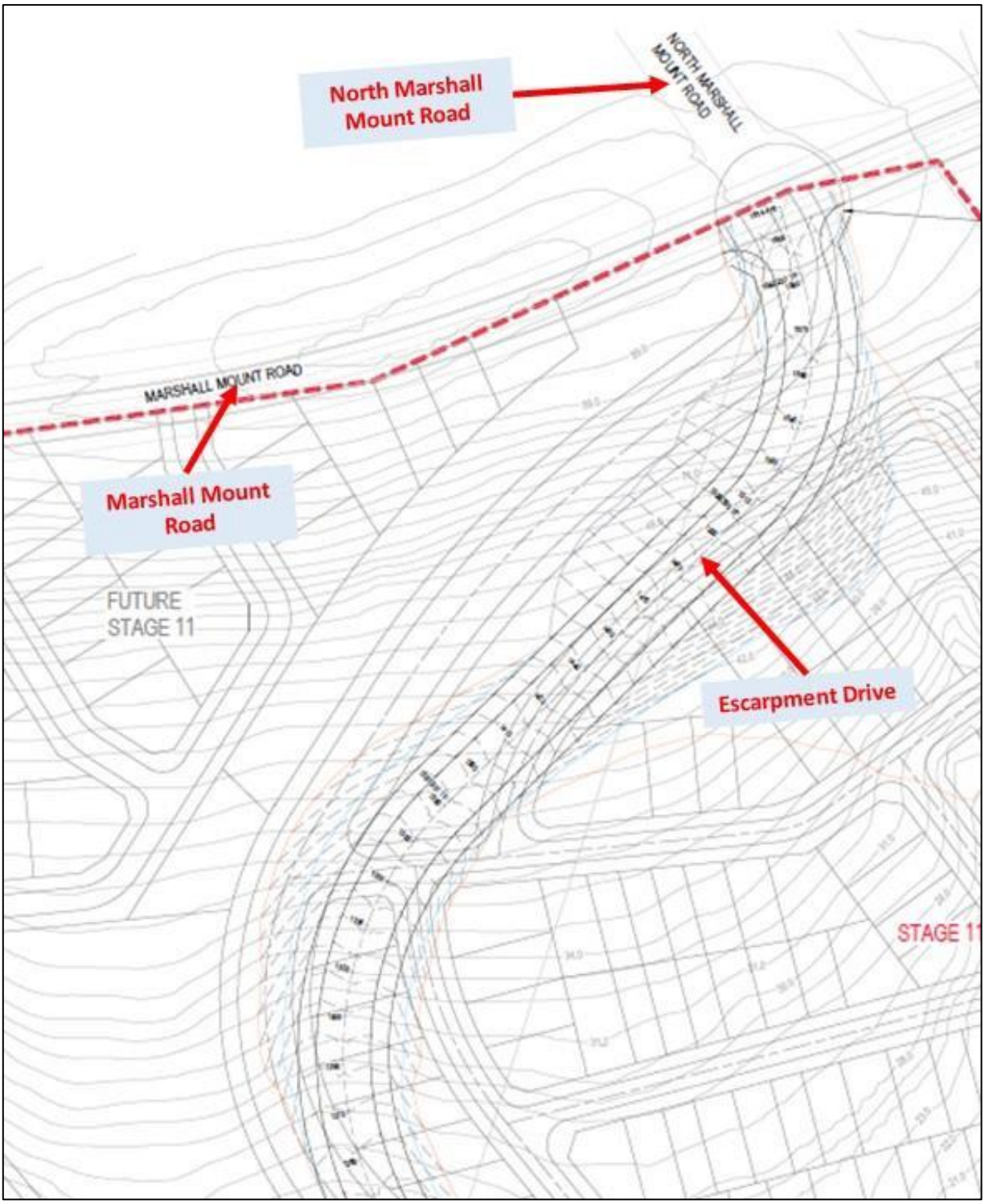


Figure 4-7 Indicative Layout Plan of Marshall Mount Road / North Marshall Mount Road / Escarpment Drive Intersection

b. Option B (Preferred Design)

It is anticipated from traffic assignment and modelling results that there will be high Average Daily Traffic (ADT) volume on Escarpment Drive (ADT = 14,230) as compared to Marshall Mount road (ADT = 3,829) and North Marshall Mount Road (ADT = 4,622). Additionally, the Escarpment Drive will potentially carry trunk bus route services at the full development of the CUDP.

Considering the aforementioned factors, two priority control T-intersections at Marshall Mount Road / Escarpment Drive and North Marshall Mount Road / Marshall Mount Road have been proposed as a preferred option instead of four-leg roundabout, shown in **Figure 4-6.**

The basic aim of this proposal is to prioritize through traffic and to facilitate bus movement on Escarpment Drive. The indicative road geometry and modelling results for future year 2036 are illustrated in **Figure 4-8.**

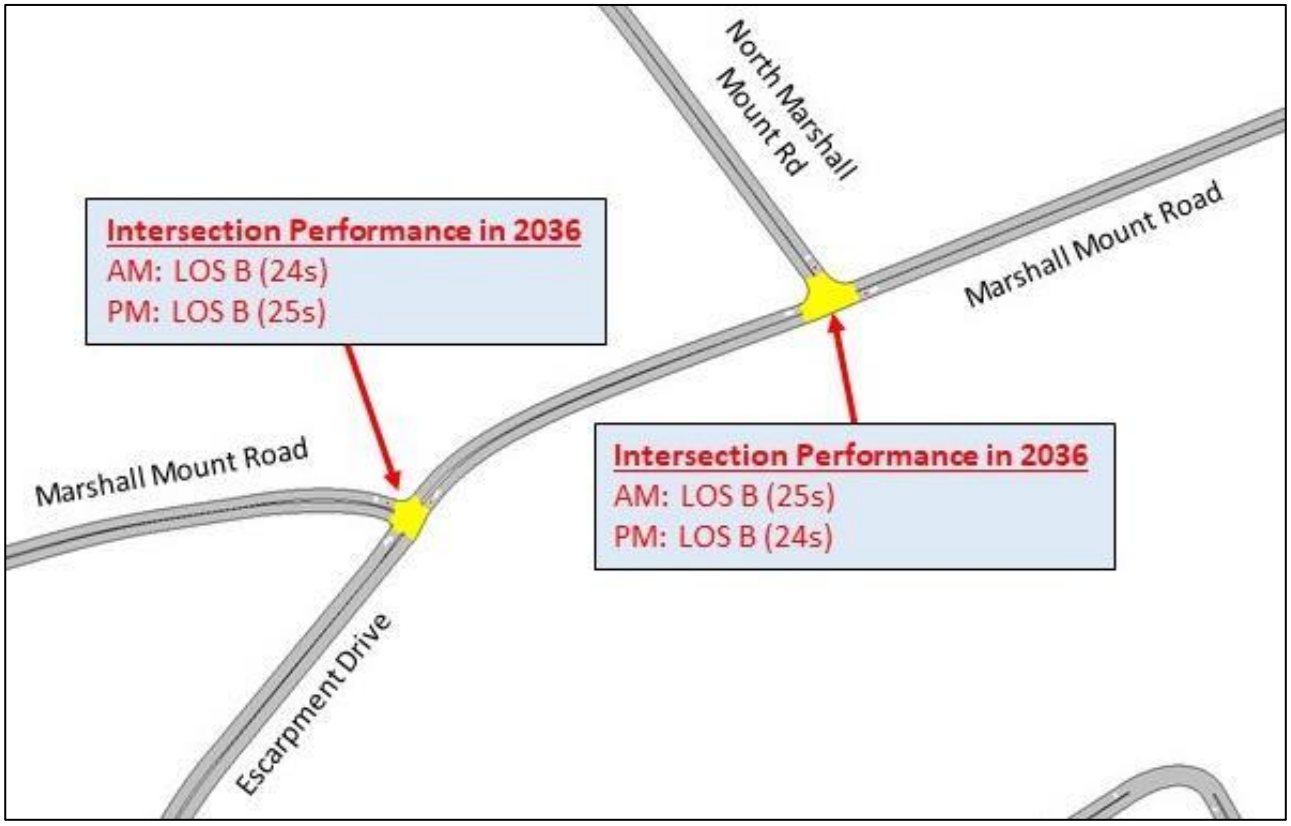


Figure 4-8 Assessment of Marshall Mount Road / Escarpment Drive Intersection and North Marshall Mount Road / Marshall Mount Road Intersection

It is evident that Marshall Mount Road / Escarpment Drive and North Marshall Mount Road / Marshall Mount Road intersections are expected to operate at LoS “B” in both AM and PM peak in future year 2036. A sketch of the proposed intersection is shown in **Figure 4-9**.

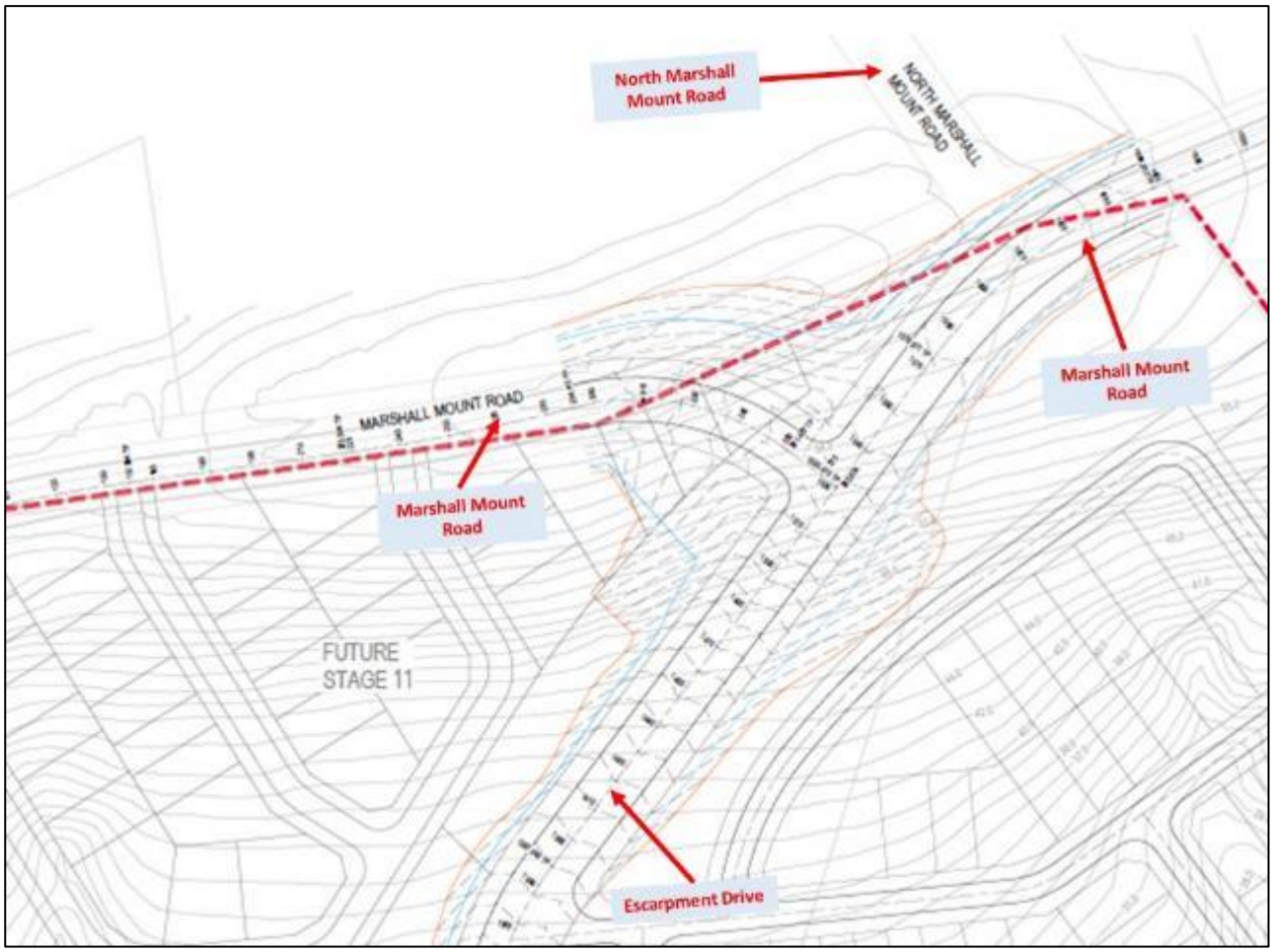


Figure 4-9 Indicative Layout Plan of Marshall Mount Road / Escarpment Drive Intersection and North Marshall Mount Road / Marshall Mount Road Intersection

4.2.4 Future Works

Based on the above modelling assessment, it is recommended that the following two intersections are proposed to be upgraded from roundabout to signalised intersections due to the proposed increase in CUDP yield:

- Illawarra Highway / Broughton Avenue intersection
- Tripoli Way / Calderwood Road intersection.

As per consultation with Roads and Maritime, the RMS has a preference for enabling road works to be delivered as works in kind. Both abovementioned upgrades could be considered for delivery as works in kind, and this mechanism is currently provided for in the State Planning Agreement. Therefore, there is no change required to the current State VPA in terms of delivery. However, it should be noted that the upgrades will create impacts on the land outside of the Lendlease control. An appropriate apportionment of costs should be determined considering the relative benefits to other development sites and the general travelling public.

As described in **Section 4.2.3.2.2**, two priority control T-intersections at Marshall Mount Road / Escarpment Drive and North Marshall Mount Road / Marshall Mount Road have been proposed as a preferred option. It also involves change in alignment for Escarpment Drive and Marshall Mount Road. The works required for modifications in alignment of Escarpment Drive and Marshall Mount Road could be considered for delivery as works in kind.

4.2.5 Conclusions

- All intersections, for which upgrades were proposed in TMAP (2010), were reassessed with increased yield to analyse impacts of increased yield and to propose additional upgrades.

- Upgrade of roundabout intersection was proposed for Illawarra Highway / Broughton Avenue and Calderwood Road / Tripoli Way intersections in TMAP (2010) to accommodate future year 2031 traffic (without CUDP yield).
- As per the current traffic modelling assessment (for 2036), Illawarra Highway / Broughton Avenue and Calderwood Road / Tripoli Way intersections are both recommended to be signalised. The State VPA assume roundabouts for both these intersections, as per the TMAP (2010). The funding mechanism for additional upgrades should consider the relative benefits to other development sites and the general travelling public.
- Considering the high Average Daily Traffic (ADT) volume on Escarpment Drive as compared to Marshall Mount Road and North Marshall Mount Road, priority control T – intersection has been proposed (as preferred option) at Marshall Mount Road / Escarpment Drive Intersection and North Marshall Mount Road / Marshall Mount Road Intersection.
- Calderwood Road / Escarpment Drive Intersection is expected to operate at satisfactory LoS with signalised intersection control.

4.3 SEARs Part 3: Road Performance Assessment

As described in **Section 3.3**, the town centre area of 25,000sqm retail floor space and 20,000 of non-retail floor space was already assumed for TRACKS model development, as part of the TMAP study (2010). Thus, this traffic and transport report only considers the impacts of proposed residential yield increase from 4,800 to 6,500 dwellings to assess the impacts on existing and planned road network in the area of influence.

A comparative assessment was undertaken using TRACKS model to analyse the impacts of the proposed yield increase, from 4,800 to 6,500 dwellings, on road infrastructure in the area of influence. **Section 4.1** "Modelling of Impacts" and **Table 4-1** describes in detail the difference between the existing and proposed land use scenarios.

4.3.1 Assessment of Additional Traffic Volume on Road Network

In order to assess the increase in traffic volume at key roads (for 2036 horizon year) in the area of influence due to proposed yield increase, mid-block volumes for approved and proposed scenario was extracted from TRACKS model. **Table 4-6** describes the maximum increase in trips (in any direction) on key roads in the AM peak hours. It is evident that there will be increase in trips on Calderwood Road, Escarpment Drive and Marshall Mount Road.

Table 4-6 AM Peak - Mid-Block Volume Assessment for Key Road

Additional Trips on Key Roads (2036 horizon) - AM Peak				
Road	**No. of Vehicles Without Proposed Yield**	**No. of Vehicles With Proposed Yield**	**Difference**	**Direction of Travel**
Calderwood Road	705	790	85	Eastbound
Escarpment Drive	506	631	125	Northbound
Marshall Mount Road	552	652	100	Northbound
Tongarra Road	1238	1296	58	Eastbound
Yallah Road	681	746	65	Eastbound
Princes Motorway	1399	1445	46	Northbound
Princes Highway	2226	2260	34	Northbound

Table 4-7 highlights the maximum increase in trips (in any direction) on key roads in the PM peak hours. There will be increase in trips on Calderwood Road and Escarpment Drive with minor increase in traffic on Yallah Road, Princes Motorway and Princes Highway. As evident from the **Table 4-6** and **Table 4-7** that the increase in trips is forecast to be more in the AM peak as compared to the PM peak.

Table 4-7 PM Peak - Mid-Block Volume Assessment for Key Road

Additional Trips on Key Roads (2036 horizon) - PM Peak				
Road	**No. of Vehicles Without Proposed Yield**	**No. of Vehicles With Proposed Yield**	**Difference**	**Direction of Travel**
Calderwood Road	266	493	227	Eastbound
Escarpment Drive	517	600	83	Southbound
Marshall Mount Road	557	618	61	Southbound
Tongarra Road	1255	1330	75	Westbound
Yallah Road	761	784	23	Westbound
Princes Motorway	1376	1399	23	Southbound
Princes Highway	2851	2866	15	Southbound

The forecast growth in the traffic, due to proposed yield increase, on all roads within the area of influence is illustrated in **Figure 4-10** and **Figure 4-11** for both AM and PM peak periods respectively.

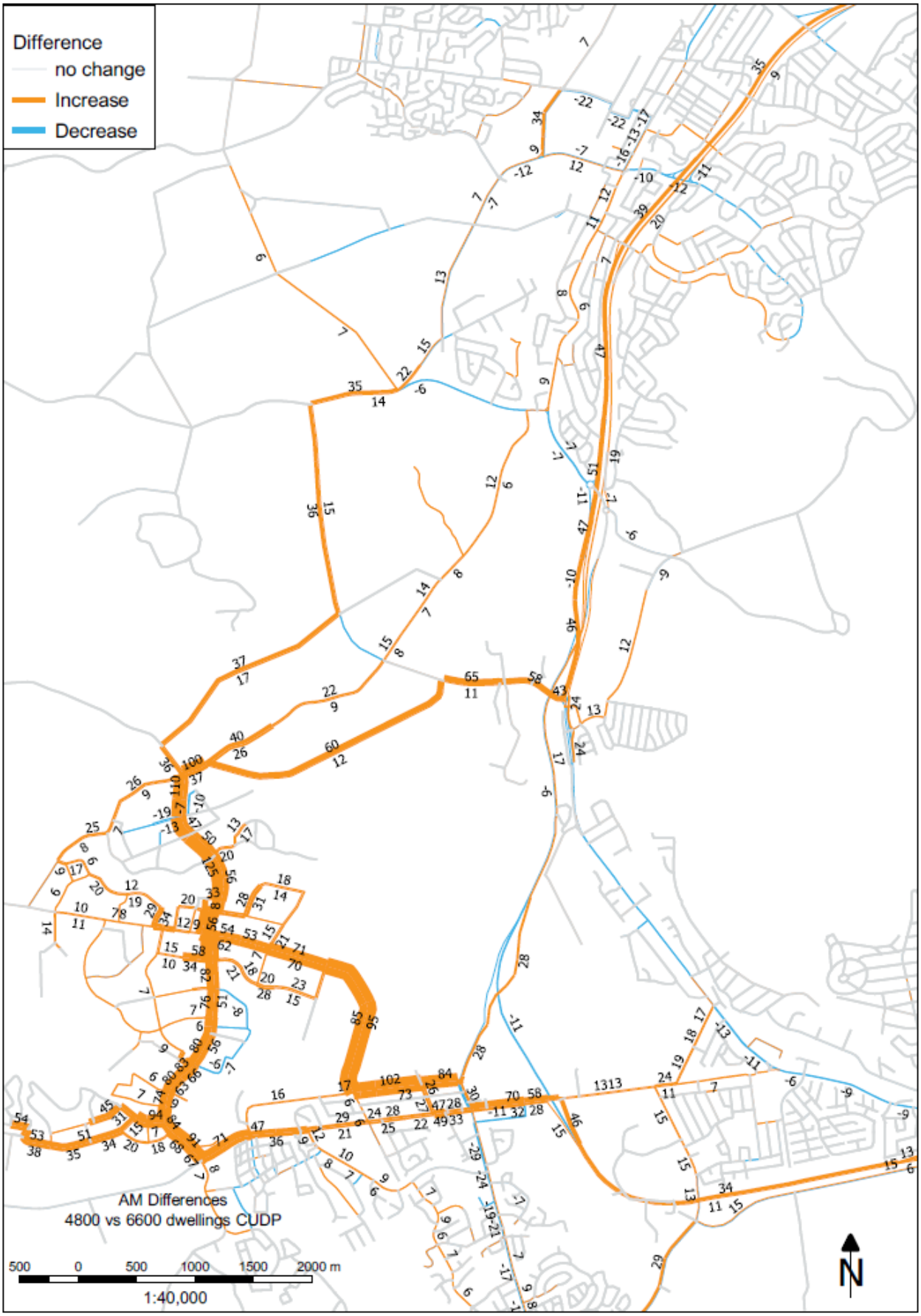


Figure 4-10 AM Peak Mid-Block volume difference between existing / approved (TMAP, 2010) and proposed yield increase scenario

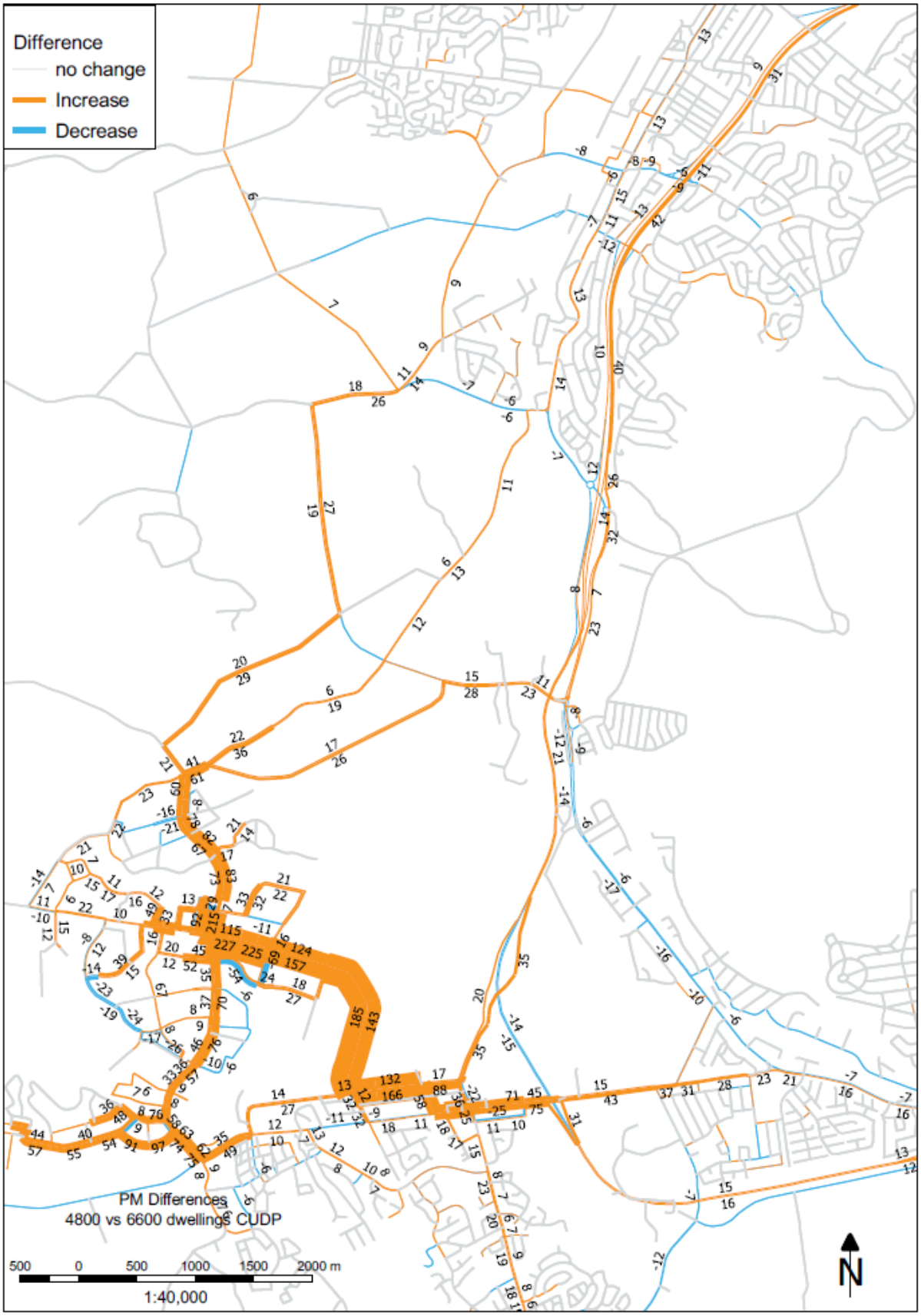


Figure 4-11 PM Peak Mid-Block volume difference between existing / approved (TMAP, 2010) and proposed yield increase scenario

It is evident from **Figure 4-10** and **Figure 4-11** that there is an increase in traffic volumes on Escarpment Drive, Tripoli Way and, in particular, Calderwood Road between Tripoli Way and the eastern boundary of CUDP. As shown in **Figure 4-10** and **Figure 4-11**, a majority of the trips generated due to increased yield will most likely use Escarpment Drive, Calderwood Rad and Tripoli Way to access Princes Motorway (M1), once the Albion Park Rail Bypass is open for travelling. In addition, significant number of trips will use Tongarra Road to travel towards Shellharbour.

Considering the increase in traffic flow on Calderwood Road, particularly from Tripoli Way to eastern boundary of CUDP, it is recommended to upgrade this section of Calderwood Road from a 2-lane road to a 4-lane road. This includes widening of the existing bridge over Macquarie Rivulet. Although the mid-block capacity of Calderwood Road is unlikely to be exceeded until full completion of the CUDP, it is recommended that the Calderwood Road upgrade is completed on the opening of the town centre (retail) and completion of the Tripoli Way by-pass, which is anticipated to occur in 2026-2028. This will provide a conforming, safe road geometry appropriate to the sub-arterial function of the road.

- To ensure safe pedestrian and cyclist connectivity between Calderwood and Albion Park.
- To serve as an appropriate “gateway” to the CUDP.

In addition to mid-block volume difference analysis, Volume – Capacity Ratio (V/C Ratio) analysis was also undertaken as part of the road performance assessment.

4.3.2 AM Peak V/C Ratio Analysis

The V/C Ratio Analysis was undertaken for both existing / approved (TMAP, 2010) and proposed yield increase scenarios with yield of 4,800 dwellings and 6,500 dwellings respectively. The V/C ratio has been distributed into different band range and each band has been attributed with specific colour as illustrated in **Figure 4-12.**

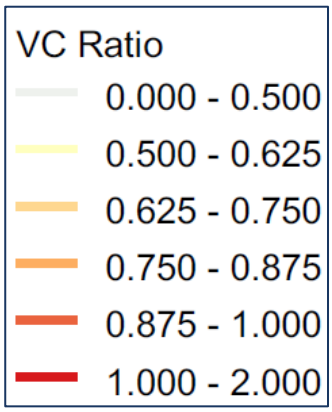


Figure 4-12 V/C Ratio Band Range

Figure 4-13 and **Figure 4-14** illustrates the AM peak V/C ratio of all road networks within the area of influence of CUDP for existing approved scenario with 4,800 dwelling yield and proposed scenario with 6,500 dwelling yield respectively.

Figure 4-13 AM Peak V/C Ratio for Approved Scenario with 4,800 Dwellings

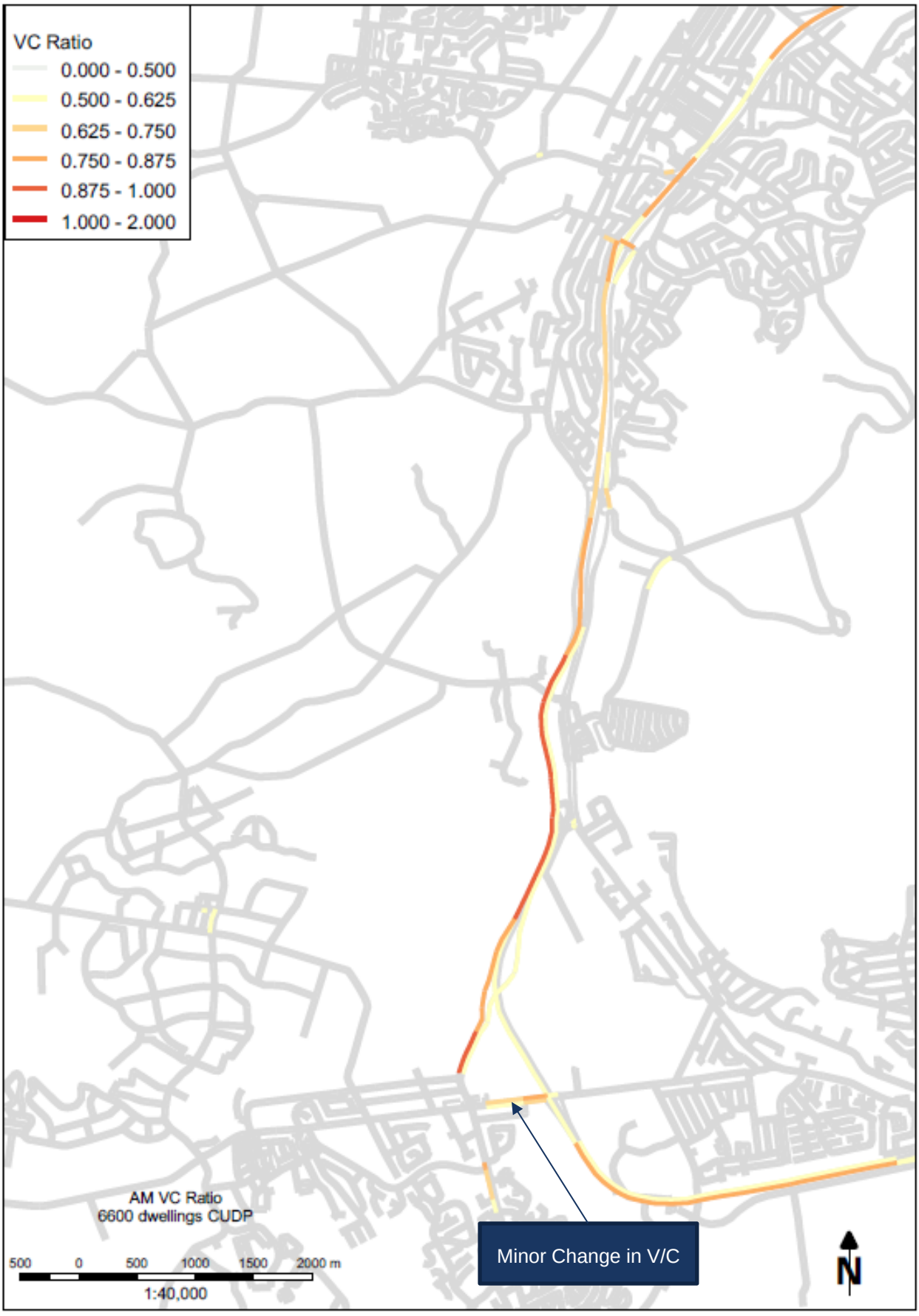


Figure 4-14 AM Peak V/C Ratio for Proposed Scenario with 6,500 Dwellings

It is evident from **Figure 4-13** and **Figure 4-14** that there is no significant change in V/C ratio on any road within the area of influence of CUDP. As highlighted in **Figure 4-14,** minor change in V/C ratio was observed on Tongarra Road and on Albion Park Central Interchange (on southern side of Tongarra Road).

4.3.3 PM Peak V/C Ratio Analysis

In line with AM peak V/C ratio analysis, V/C ratio analysis was also carried out for PM peak of both scenarios i.e. for existing approved scenario with 4,800 dwellings and proposed scenario with 6,500 dwellings. **Figure 4-15** and **Figure 4-16** illustrate the V/C ratio analysis for existing and proposed scenarios respectively. The V/C ratio band's range was same as illustrated in **Figure 4-12.**

Figure 4-15 PM Peak V/C Ratio for Approved Scenario with 4,800 Dwellings

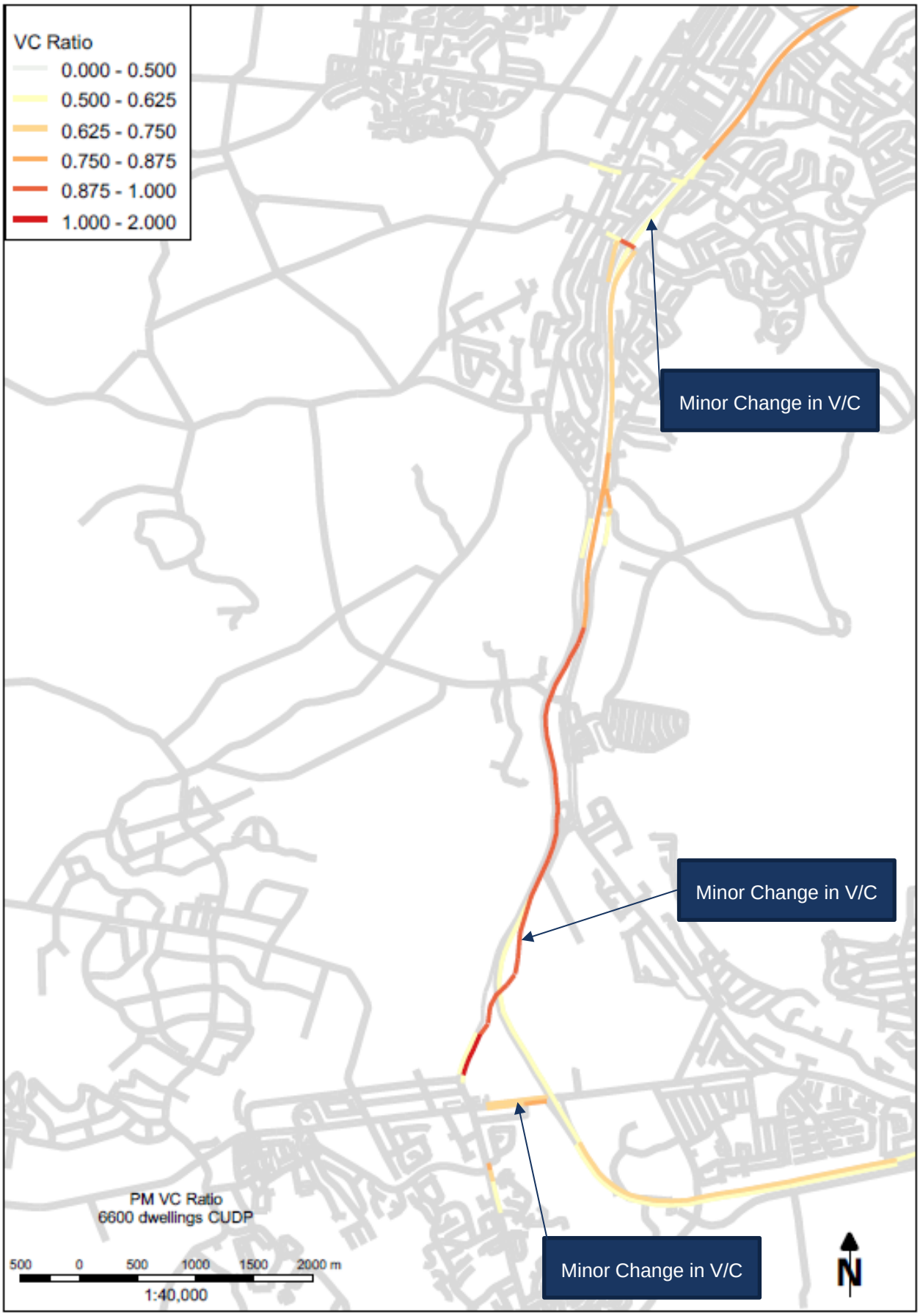


Figure 4-16 PM Peak V/C Ratio for Proposed Scenario with 6,500 Dwellings

As highlighted in **Figure 4-16**, no substantial change in V/C ratio was observed in the PM peak due to increased CUDP yield except for minor changes at Tongarra Road, Princes Motorway (M1) southbound off-ramp (APRB Central Interchange) and Princes Motorway (M1) section between Fowlers Road and Emerson Road.

4.3.4 Wollongong City Council Voluntary Planning Agreement (VPA)

In 2016/2017 Lendlease and Wollongong City Council conducted extensive negotiations in response to Condition C12 of the approved Concept Plan. These negotiations were undertaken in consultation with the Department of Planning and Environment as required by Condition 12. In terms of local road upgrades, Condition C12 required that (in the Wollongong LGA):

- ***Local roads*** *– contribution towards the following road works are supported. The total cost, apportionment and timing of these works shall be determined in consultation with the Department of Planning:*
  - *Upgrade of Marshall Mount Road (referred to in the TMAP as 22, 23 & 24);*
  - *Upgrade of Yallah Road from Marshall Mount Road to Haywards Bay Drive (referred to in the TMAP as 25);*
  - *Upgrade to the intersection of Marshall Mount Road and Yallah Road (referred to in the TMAP as 36);*

These discussions focused on the apportionment of costs to Lendlease as a result of Calderwood traffic utilising the new roads in West Dapto URA. As documented in *Calderwood Review of S94 Plan Apportionment Process* (Cardno, 2017), TRACKS was used to forecast average daily traffic (ADT) and CUDP apportionment on the following key roads:

- Town Centre Bypass (TCB)
- Marshall Mount Road
- Yallah Road
- NR1 – NR 3

Following are the two key points regarding this comparison:

- For the purposes of the modelling done as part of the VPA discussions, the CUDP yield was assumed to be 6,000 dwellings.
- For the purposes of the modelling done as part of the VPA discussions, the West Dapto Urban Release Area was assumed to be at full development (circa 2060 scenario).

To ensure consistency with the findings of the VPA discussions, an assessment was undertaken to determine the maximum increase in trips on the above-mentioned key roads, travelling to and from CUDP, due to the proposed yield increase. The results of the assessment are shown in **Table 4-8** and maps illustrating the additional trips in both AM and PM peak on all roads within the area of influence are provided in **Figure 4-10** and **Figure 4-11** respectively.

Considering the relatively minor increase in traffic volumes on key roads in the study area, it is concluded that no further road upgrades would be required above and beyond the VPA agreement as a result of the CUDP yield review.

Table 4-8 Increase in the peak hour (AM and PM) trips for key roads funded through WCC VPA

Road	AM – Peak Increase in Traffic		PM – Peak Increase in Traffic	
	Outbound	Inbound	Outbound	Inbound
Town Centre Bypass (TCB)	60	12	17	26
Marshall Mount Road *(Between North Marshall Mount Road / Marshall Mount and Marshall Mount Road / TCB intersections)*	100	37	41	61
Marshall Mount Road *(Between Marshall Mont Road / TCB and Marshall Mount Road / Yallah Road intersections)*	40	26	22	36

Road	AM – Peak Increase in Traffic		PM – Peak Increase in Traffic	
	Outbound	Inbound	Outbound	Inbound
Marshall Mount Road *(To North - After Marshall Mount Road / Yallah Road intersection)*	15	8	6	13
NR 1 – NR 3	35	15	19	27
Yallah Road *(Between Marshall Mount Road / Yallah Road and Yallah Road / TCB intersections)*	0	0	0	0
Yallah Road *(To East - After Yallah Road / TCB intersections)*	65	11	15	28

4.3.5 Employment Sensitivity Analysis

During an agency consultation meeting, RMS requested an employment-based sensitivity analysis to assess the impacts on Vehicle Kilometres Travelled (VKT) and Vehicle Hours Travelled (VHT) within the modelled road network.

Cardno considered the following five employment sensitivity scenarios within the CUDP:

- Lower (50% reduction in the employment i.e. 50% of the actual employment).
- Low (25% reduction in the employment i.e. 75% of the actual employment).
- Base (No change in the employment i.e. 100% of the actual employment).
- High (25% increase in the employment i.e. 125% of the actual employment).
- Lower (50% increase in the employment i.e. 150% of the actual employment).

Table 4-8 shows the impacts on global travel time and travel distance in the various employment scenarios.

Table 4-9 CUDP Employment Sensitivity Analysis (VKT and VHT)

Employment Sensitivity Analysis										
Employment Sensitivity Scenarios			**AM**				**PM**			
Type	**Town Centre Jobs**	**Variation (%)**	**VKT**	**Impact**	**VHT**	**Impact**	**VKT**	**Impact**	**VHT**	**Impact**
Lower	595	50%	945,371.90	990	1,096,873.20	3,392	958,983.20	465	1,164,907.20	3,172
Low	892	75%	944,599.20	217	1,095,220.20	1,739	959,259.90	742	1,163,525.80	1,791
Base	1,190	100%	944,382.00	0	1,093,481.50	0	958,518.10	0	1,161,735.10	0
High	1,487	125%	944,175.50	-207	1,092,375.90	-1,106	958,091.40	-427	1,160,268.10	-1,467
Higher	1,785	150%	943,616.70	-765	1,091,282.00	-2,200	957,452.00	-1,066	1,158,372.20	-3,363

As shown in **Figure 4-17** and **Figure 4-18**, the VKT and VHT values increase as employment is reduced within the CUDP. Conversely, the VKT and VHT values drop significantly when employment in Calderwood is increased. Therefore it can be concluded that increasing local employement within the CUDP has a net positive impact on the road network.

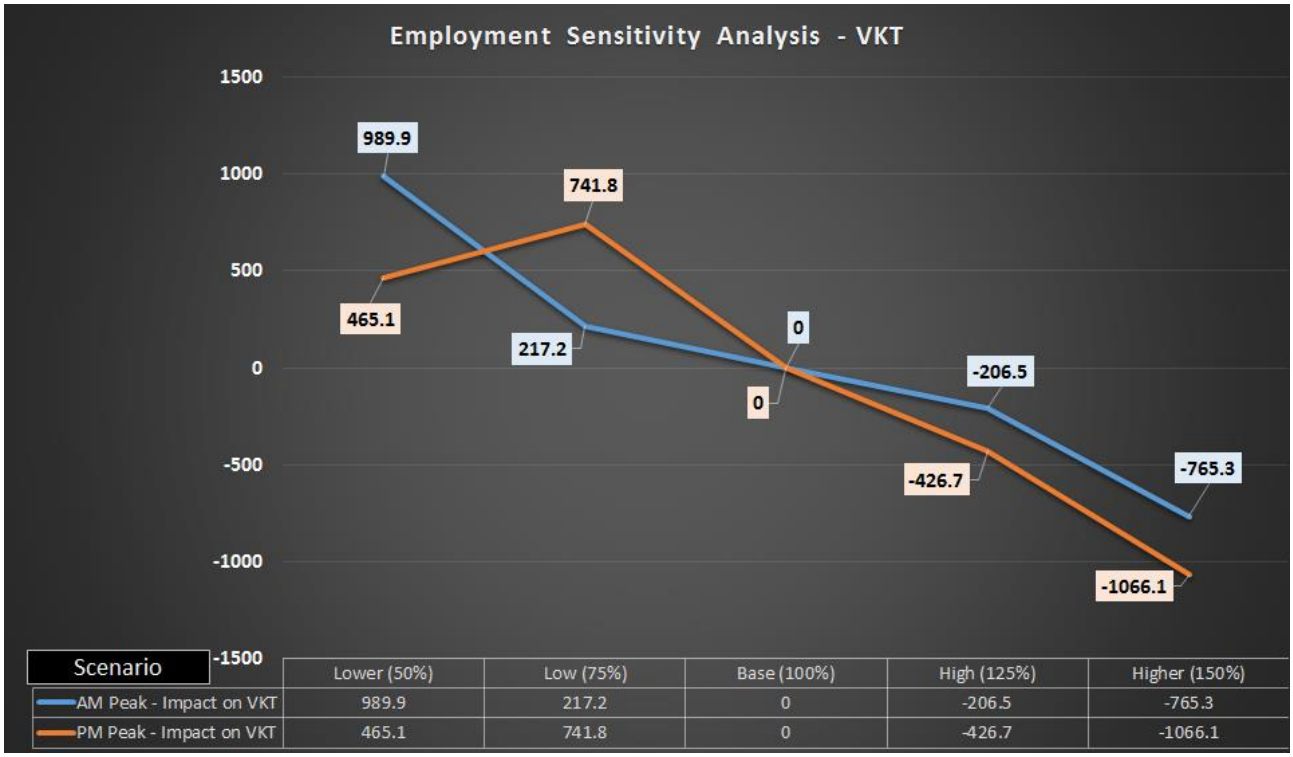


Figure 4-17 Employment Sensitivity – VKT

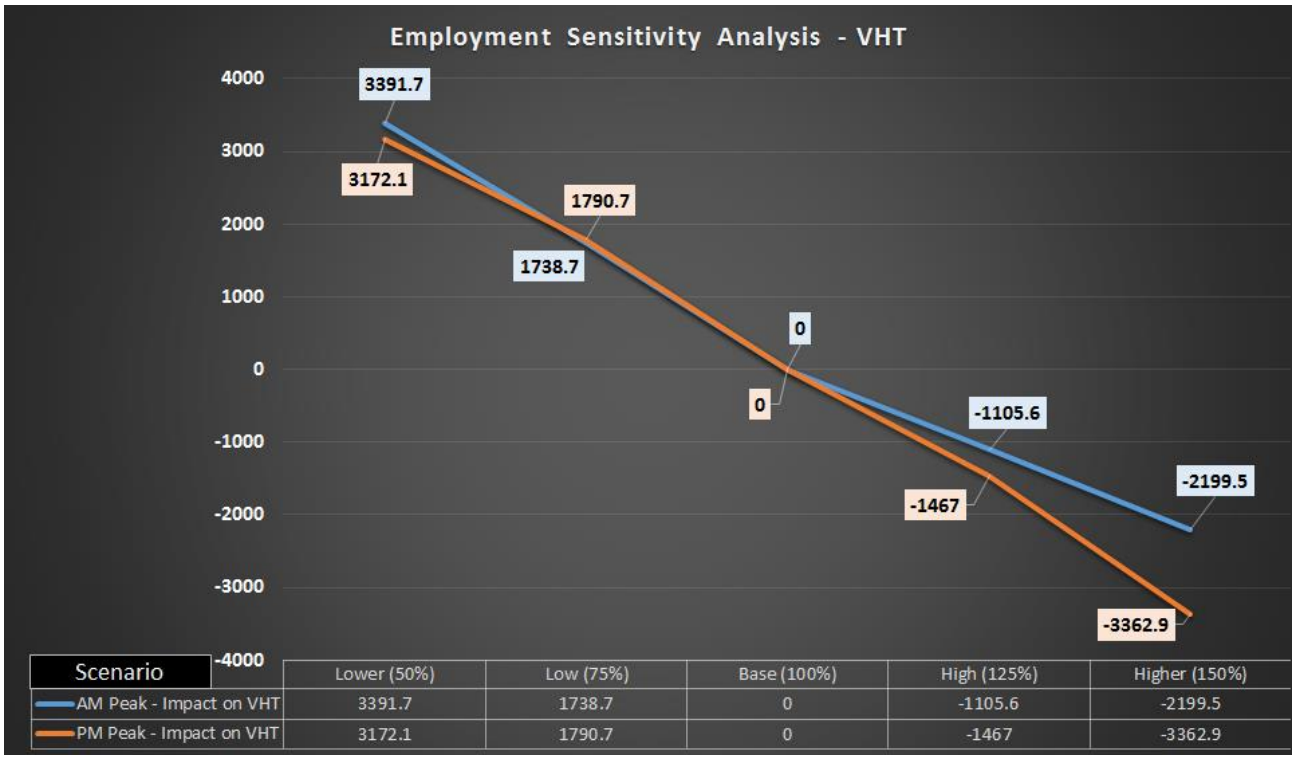


Figure 4-18 Employment Sensitivity - VHT

4.3.6 Conclusions

- There is an increase in traffic volumes on Escarpment Drive, Tripoli Way and Calderwood Road (between Tripoli Way and eastern boundary of CUDP) due to the increase in CUDP yield.
- In order to accommodate additional traffic associated with the proposed modification, road widening is proposed for Calderwood Road, from Tripoli Way to the eastern boundary of the CUDP, from 2-lanes to 4-lanes. The requirement to upgrade Calderwood Road is anticipated to coincide with the opening of Calderwood Town Centre (retail) and Tripoli Way works, which is anticipated to occur around 2026-2028, depending on market conditions and development approvals.
- No significant change is observed in V/C ratio of all roads within the area of influence due to the increase in CUDP yield.
- The CUDP yield increase will not impact on the road infrastructure requirements identified in the WCC VPA discussions.
- Local employment in Calderwood has a net positive impact on the road network.

4.4 SEARs Part 4: Internal Road Network and Parking

This section details plans and assessment of any changes to the layout of the internal road network and on-site parking in accordance with the relevant Australian Standards

4.4.1 Background Review of CUDP Internal Road Network

4.4.1.1 Assumptions / Description for Internal Road Network (TMAP, 2010)

As per Appendix 5E “Future CUDP Road Network” of TMAP (2010), following key assumptions / description were made for CUDP internal road network:

- A north-south sub-arterial road providing two-lane two-way traffic operation (ie one traffic lane in each direction) through the precinct forming the main precinct spine road. The sub-arterial road would accommodate bus movements and be designed for an 80 km/h design speed but carry a posted 60 kph speed limit. Due to the sub- arterial function it would be desirable to limit direct access from it and also limit the number of intersection along its length to permit the free flow of traffic. Carriageway edge friction (from parking movements) along its length should be minimised except in the town centre area where a concentration of on-street parking opportunities may be desirable
- Major collector Roads would form the links between the sub arterial road and minor collector roads. These roads would be two-lane two-way (i.e. one traffic lane in each direction) and would also carry bus movements and provide a lower speed environment (50kph or lower would be desirable). The lower speed environment would also be reinforced through design features in the horizontal and geometric design, and the use of roundabouts at four way intersections.
- Minor collector Roads would form the lowest level of road within the hierarchy and would provide direct access opportunities to individual dwellings. Roads would ideally be subject to 40kph speed limits reinforced through appropriate horizontal and vertical design and intersection control strategy.

The road network and its internal intersections would be designed to accommodate the largest anticipated vehicle types required to serve the retail, commercial and industrial uses within the precinct.

External connections between the CUDP internal road network and the existing/planned road network are as follows:

- A connection from the north-south sub arterial road to the existing Marshall Mount Road at its northernmost section is proposed. Such an intersection form would provide an appropriate gateway feature for entry/exit movements to the precinct. A three arm roundabout is assessed such that the major collector road forming the CUDP north-western boundary can tie into the north-south sub arterial/Marshall Mount Road.
- The southern end of the north-south sub arterial road (Escarpment Drive) would connect to the external road network via a four arm roundabout at the location of the existing Illawarra Highway /Yellow Rock Road priority controlled intersection. A roundabout is considered an appropriate form of intersection control at this location due to consistency of intersection types along the Illawarra Highway, its ability to act as a speed control device for through traffic and to provide adequate capacity and safety performance. The construction of Escarpment Drive / Illawarra Highway / Yellow Rock Road roundabout is now completed.

- A minor collector road would connect to the Illawarra Highway at the eastern end of the southern CUDP frontage as a fourth (northern arm) to the existing Illawarra Highway / Broughton Avenue roundabout
- At the western edge of the CUDP southern frontage two priority controlled intersections would be provided to connect the minor and major collector roads to the Illawarra Highway. The major collector road would connect where North Macquarie Road currently connects. These intersection types would provide appropriate capacity to serve the lower traffic volumes on both the CUDP internal road network and the Illawarra Highway at this location
- Calderwood Road provides an existing east-west route through the CUDP. It is proposed to upgrade and re-align the extent of the road within the internal CUDP internal road network to a major/minor collector road. Its outward eastward connection to the external road network will therefore similarly need to be upgraded from its current rural narrow non-delineated state to one appropriate to its functional role within the road hierarchy. To the west of the site Calderwood Road will be retained in its current form
- Access to North Marshall Mount Road will remain off Marshall Mount Road.

4.4.1.2 CUDP Internal Road Network (TMAP, 2010)

An indicative road network layout and hierarchy was approved as part of the Concept Plan (Figure 12 of the Consolidated Concept Plan). The key features of the road network:

- Key external road connections include:
  - Marshall Mount Road in the north-west
  - Calderwood Road to the east and the west
  - Four connections to the Illawarra Highway are proposed:
    - At the existing Illawarra Highway/Broughton Avenue intersection
    - At the existing Illawarra Highway/Yellow Rock Road intersection
    - To the east of the existing North Macquarie Road Intersection
    - At the existing Illawarra Highway/North Macquarie Road intersection
- A north-south sub-arterial road that connects to:
  - The Illawarra Highway in the south opposite Yellow Rock Road
  - Marshall Mount Road in the north near North Marshall Mount Road
- North Macquarie Road is retained to the west of the site although its central section within the CUDP site is realigned
- Calderwood Road is retained to the east and west of the site although its central section within the CUDP site is realigned
- Marshall Mount Road is retained in its current alignment forming a boundary along the north-western portion of the site
- Access to North Marshall Mount Road will remain off Marshall Mount Road
- Major Collector Roads serving each precinct, designed to facilitate the use of regular bus services.

It was also recommended in the TMAP and the approved DCS that the detailed form of the road network including intersection controls and cross-sections will be assessed through individual applications. It is understood that detailed design and placement of these roads will need to take into consideration the drainage regime of the site and the configuration and layout of lots to promote flexibility at DA/PA stage and this principle is adopted in the DCS.

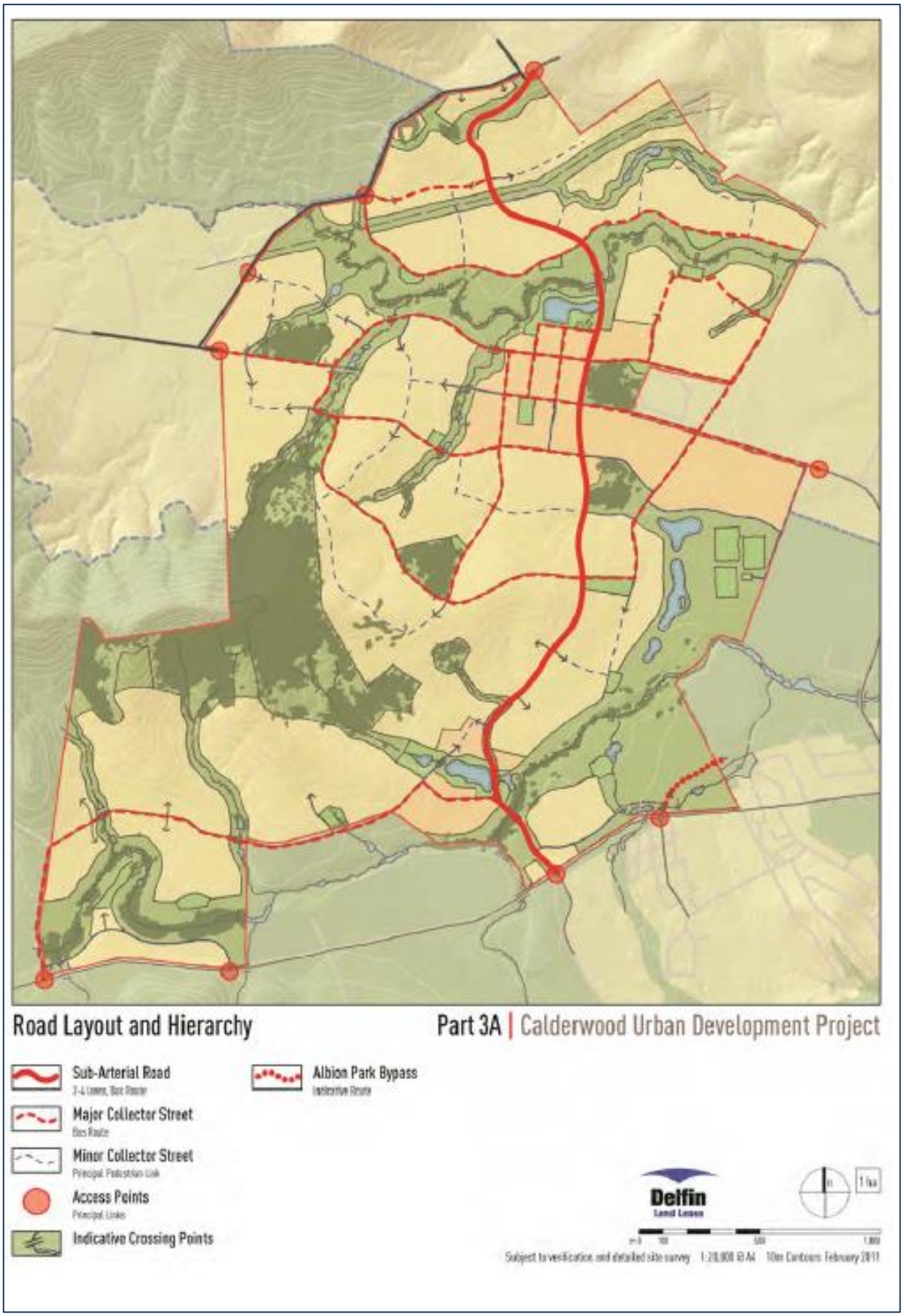


Figure 4-19 Approved Concept Plan Road Layout and Hierarchy

Source: Consolidated Concept Plan (JBA, 2011).

4.4.1.3 Modification C5 (CUDP Concept Plan, 2011)

Modification C5 of the approved Concept Plan requires:

- A detailed traffic assessment to be submitted with the relevant application for subdivision and infrastructure works for each future stage of the project, with regard to:
  - Identification of the traffic generated by that particular stage of the development, having regard to the RTA Guide to Traffic Generating Developments.
  - Existing capacity of surrounding road network and its ability to accommodate the development proposed within the Stage, including consideration of timing of the construction of the F6 extension and Tripoli Way Bypass.
  - Identification of the upgrades to the local roads, required to accommodate that stage.
- A detailed design plans for the proposed road works to be undertaken as part of each Stage to be submitted with the relevant application for subdivision and infrastructure works, including:
  - Plans for the upgrades to be undertaken as works in kind including details of proposed timing / staging for the completion of the works.
  - Plans for proposed internal road and parking arrangements, including number of parking spaces, and details of bicycle and pedestrian facilities.

4.4.1.4 CUDP Internal Road Network (DCS, 2018)

The new street typology and changes to existing typologies are proposed in the DCS (See **Figure 4-20**) to allow for flexibility in urban design of the streetscape and also to provide opportunities to introduce the new housing typologies proposed. It is noted that these street types will be subject to a thorough engineering design and review as part of the DA process.

Several existing street types have been amended (A1, A2, B1, B2, C1, C2, D1 and D2) in the revised DCS. The changes include a general increase in travel lane width, reduction in median width and cycle lanes, resulting in (generally) a reduction in overall carriageway widths. Footpaths have been increased in size where possible.

One new street typology is also proposed to be introduced into the DCS which is to be known as B3 Major Collector adjacent Rural Lands. This new street typology is proposed to be located in areas adjacent to rural lands as shown highlighted yellow in **Figure 4-20**. It is proposed to only provide a footpath on one side of the major collector road in these parts of the site as limited pedestrian movement will occur along the rural interface and thus the provision of a second footpath is not warranted. The B3 Major Collector cross-section is based on a recent project delivered for Wollongong City Council in West Dapto.

The revised design standards for the street types to be provided in Calderwood and comparison with the approved DCS (2011) are described in Section 1.1 of CUDP DCS and are reproduced in **Table 4-10.** As can be seen from the comparison, travel lanes and footpaths are generally wider than the approved DCS. Where dimensions are reduced (for example parking lanes), minimum requirements are maintained in accordance with relevant standards and guidelines.

The indicative cross-sections for CUDP roads are described in **Appendix C**.

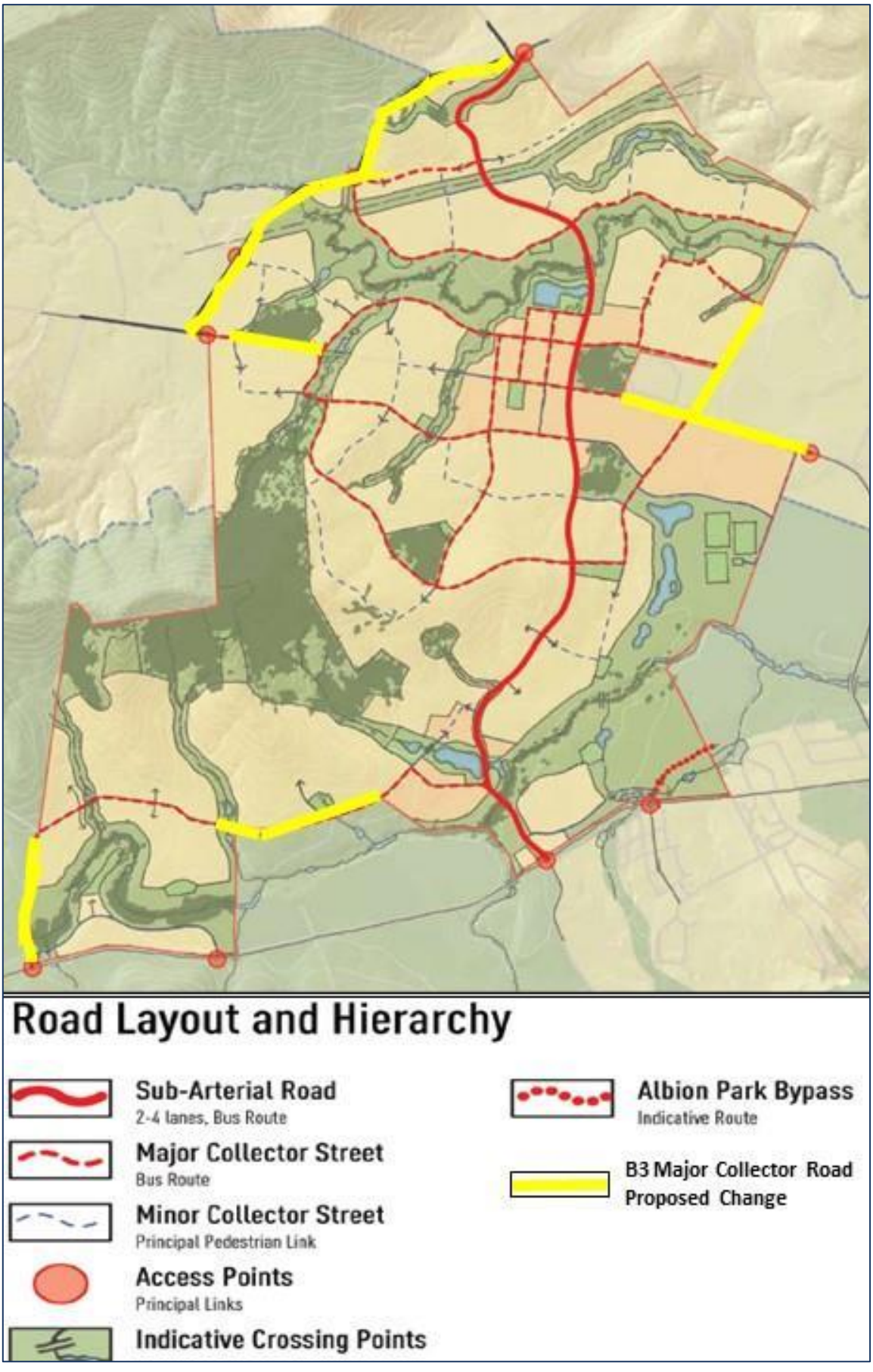


Figure 4-20 Revised Road Layout and Hierarchy

Source: CUDP Development Control Strategy (Ethos Urban , 2018)

Table 4-10 Street Type to be provided in Calderwood - Comparison of DCS 2011 and DCS 2018

Street Type		DCS Type	Carriageway (metres)					Verge (metres)		
Sub Arterial Road		**DCS Version**	**Travel Lanes**	**Median**	**On- Street Cycle Lane No.**	**Parking**	**Carriageway Width**	**Verge Width**	**Total Reserve**	**Footpath**
A1	**Sub Arterial** with Parking on both sides and bus service	2011	7.8	0	2	5.6 (2.8 + 2.8)	13.4	10.6 (5.3 each side)	24	3 (1.5 + 1.5)
		2018	7.8	0	**0**	5.6	13.4	10.6 (5.3 each side)	24	**4 (1.5 + 2.5)**
A2	**Sub Arterial with Median** and one-way traffic lanes with parking	2011	9.4 (4.7 + 4.7)	Varies	2	5.6 (2.8 + 2.8)	15	10 (5 each side)	Varies 25 Min	3 (1.5 + 1.5) on sides (1.5 - 2.5) in median
		2018	**12.9 (6.45 + 6.45)**	Varies **(4m Min)**	**0**	**0**	**12.9**	**12.1 (6.05 each side)**	Varies 25 Min	**4 (1.5 + 2.5)**
A3	**Sub Arterial Road** (one lane in each direction with parking bays)	2011	7.8	0	2	5.6 (2.8 + 2.8)	13.4	10.6 (5.3 each side)	24	3 (1.5 + 1.5)
		2018	**7.9**	0	**0**	**5 (2.5 + 2.5)**	**12.9**	**11.6 (5.3 + 6.3)**	**28.5**	**4 (1.5 + 2.5)**
Major Collector Road		**DCS Version**	**Travel Lanes**	**Median**	**On- Street Cycle Lane No.**	**Parking**	**Carriageway Width**	**Verge Width**	**Total Reserve**	**Footpath**
B1	**Major Collector** with parking on both sides and bus service	2011	6.4	0	0	5.6 (2.8 + 2.8)	12	10 (5 each side)	22	3 (1.5 + 1.5)
		2018	**7**	0	0	**5 (2.5 + 2.5)**	12	10 (5 each side)	22	**4 (1.5 + 2.5)**
B2	**Major Collector with Median** and parking on both sides and bus route	2011	6.4 (3.2 + 3.2)	4	0	5.6 (2.8 + 2.8)	16	10 (5 each side)	26	3 (1.5 + 1.5)
		2018	**7 (3.5 + 3.5)**	4	0	**5 (2.5 + 2.5)**	16	10 (5 each side)	26	**4 (1.5 + 2.5)**
B3	**Major Collector adjacent Rural Lands**	2011	N/A							
		2018	**7**	**0**	**0**	**5 (2.5 + 2.5)**	**12**	**10 (5 each side)**	**22**	**2.5**
B4	**Major Collector with Median** and parking on both sides and bus route	2011	N/A							
		2018	**9**	**1**	**0**	**5 (2.5 + 2.5)**	**15**	**10 (5 each side)**	**25**	**4 (1.5 + 2.5)**
Minor Collector Road		**DCS Version**	**Travel Lanes**	**Median**	**On- Street Cycle Lane No.**	**Parking**	**Carriageway Width**	**Verge Width**	**Total Reserve**	**Footpath**
C1	**Minor Collector** with parking on both sides	2011	5.4	0	2	5.6 (2.8 + 2.8)	11	9 (4.5 each side)	20	3 (1.5 + 1.5)
		2018	**6**	0	**0**	**5 (2.5 + 2.5)**	11	9 (4.5 each side)	20	3 (1.5 + 1.5)
C2	**Minor Collector - Pedestrian priority Street** with parking on both sides and bus route	2011	5.4	0	0	5.6 (2.8 + 2.8)	11	12 (8.7 on one side and 3.3 on other side)	23	2.7 - 3.7 (1.5 - 2.5 + 1.2)
		2018	**6**	0	0	**5 (2.5 + 2.5)**	11	**12 (7.6 on one side and 4.4 on other side)**	23	**4 (1.5 + 2.5)**
Town and Village Centre		**DCS Version**	**Travel Lanes**	**Median**	**On- Street Cycle Lane No.**	**Parking**	**Carriageway Width**	**Verge Width**	**Total Reserve**	**Footpath**
D1	**Village Centre - Collector Road** with parking on both sides, fully paved verge and bus route	2011	6.4	0	0	5.6 (2.8 + 2.8)	12	10 (5 each side)	22	10 (5 + 5)
		2018	**7**	0	0	**5 (2.5 + 2.5)**	12	10 (5 each side)	22	10 (5 + 5)
D2	**Village Centre - Access Street** with parking on both sides and fully paved verge	2011	5.4	0	0	5.6 (2.8 + 2.8)	11	8 (4 each side)	19	8 (4 + 4)
		2018	**6**	0	0	**5 (2.5 + 2.5)**	11	8 (4 each side)	19	8 (4 + 4)
D3	**Town Centre Main Street** – parking both sides and perpendicular parking to open space edge, fully paved verge and bus route	2011	N/A							
		2018	**7**	**0**	**0**	**8.1 (2.5 + 5.6)**	**15.1**	**5 (town side) Varies (open space)**	**19**	**8 (4 + 4)**
Access Streets		**DCS Version**	**Travel Lanes**	**Median**	**On- Street Cycle Lane No.**	**Parking**	**Carriageway Width**	**Verge Width**	**Total Reserve**	**Footpath**
E1	**Access Street - Town** with on street parking and footpath on both sides	2011	7.2	0	0	On Street	7.2	8.8 (4.4 each side)	16	2.4 (1.2 on each side)
		2018	7.2	0	0	On Street	7.2	8.8 (4.4 each side)	16	**3 (1.5 on each side)**
E2	**Access Street - Standard Residential Street** with on street parking and footpath on both sides	2011	7.2	0	0	On Street	7.2	8.8 (4.4 each side)	16	1.2 - 1.5 (on one side)
		2018	7.2	0	0	On Street	7.2	8.8 (4.4 each side)	16	**1.5 (on one side)**
E3	**Access Street - Urban One Way** with on street parking and footpath on both side	2011	7.2	0	0	On Street	7.2	7 (3.5 each side)	14.2	2.4 (1.2 on each side)
		2018	7.2	0	0	On Street	7.2	7 (3.5 each side)	14.2	2.4 (1.2 on each side)
E4	**Access Street - Urban (Standard Urban Town and Village centre)** with on street parking and footpath on one side	2011	7.2	0	0	On Street	7.2	7 (3.5 each side)	14.2	1.2 - 1.5 (on one side)
		2018	7.2	0	0	On Street	7.2	7 (3.5 each side)	14.2	**1.5 (on one side)**
E5	**Access Street - APZ Edge** with optional Hike / Bike and footpath on each side	2011	6	0	0	On Street	8	6 (on one side)	Varies (12.4 Min)	1.2 - 1.5 (on one side)
		2018	**6 (8m clear path)**	0	0	On Street	8	**4.4 (on one side)**	Varies (12.4 Min)	**1.5 (on one side)**
E6	**Access Street - Country** with on street parking and footpath on one side	2011	7.2	0	0	On Street	7.2	12.8 (6.4 each side)	20	1.2 - 1.5 (on one side)
		2018	7.2	0	0	On Street	7.2	12.8 (6.4 each side)	20	**1.5 (on one side)**
E7	**Access Street with WSUD Median** parking bays on both sides plus variable width WSUM Median	2011	6 (3 + 3)	Varies	0	2.5	6	8.8 (4.4 each side)	Varies (19.8 Min)	2.4 - 3 (1.2 - 1.5) on each side
		2018	**7 (3.5 + 3.5)**	Varies	0	2.5 **each side**	6 **each side**	8.8 (4.4 each side)	Varies (19.8 Min)	3 (1.5 on each side)
E8	**Access Street - Hill Side** with variable carriageway width responding to terrain plus passing and parking bays in select locations	2011	7 (3.5 + 3.5)	Varies	0	2.5	7	6 (3 each side)	Varies (13 Min)	0
		2018	7 (3.5 + 3.5)	Varies	0	2.5	7	6 (3 each side)	Varies (13 Min)	0
Miscellaneous		**DCS Version**	**Travel Lanes**	**Median**	**On- Street Cycle Lane No.**	**Parking**	**Carriageway Width**	**Verge Width**	**Total Reserve**	**Footpath**
F1	**Lane**	2011	5	0	N/A	0	5	3 (1 + 2)	8	0
		2018	5	0	N/A	0	5	3 (1 + 2)	8	0

F2	***Open Space Edge Mews** (Parking one side, Shared Pedestrian adjacent to open space)*	*2011*	*5.6*	*0*	*N/A*	*2.5*	*8.1*	*4.3 - 4.7 (2.3 - 2.7 + 2)*	*Varies 12.4 Min*	*Shared Way*
		2018	*5.6*	*0*	*N/A*	*2.5*	*8.1*	***4.7 (2.7 + 2)***	***Varies 12.8 Min***	*Shared Way*
F3	***Access way - Mews** no parking*	*2011*	*3*	*0*	*N/A*	*2.5*	*5.5*	*4.5 (2.5 +2)*	*8*	*Shared Way*
		2018	***3.5***	*0*	*N/A*	***0***	***3.5***	*4.5 (2.5 +2)*	*8*	*Shared Way*
F4	***Access way** parking one side*	*2011*	*3.5*	*0*	*N/A*	*2.5*	*6*	*4.5 (2.5 +2)*	*10*	*Shared Way*
		2018	***5.5***	*0*	*N/A*	*2.5*	***5.5***	*4.5 (2.5 +2)*	*10*	*Shared Way*

Source: CUDP Development Control Strategy (Ethos Urban, 2018)

4.4.2 Additional Measures / Upgrades for Internal Road Networks

The key features of the CUDP internal road network are described in **Section 4.4.1.2** and street type design standards are highlighted in **Table 4-10**.

The overall concept of the internal road network described in **Section 4.4.1.1** and **Section 4.4.1.2** has not changed. There are minor changes with regard to alignment of roads which has evolved with the passage of time and development in CUDP.

The most significant change in the internal road network due to increased yield is the upgrade of Calderwood Road. Calderwood Road, between Tripoli Way and the eastern boundary of the CUDP, was planned to be a major collector road with one trafficable lane in each direction. As described in **Section 4.3**, modelling results indicate that this section of Calderwood Road will reach or exceed capacity by the ultimate development of the CUDP, inclusive of the proposed yield increase.

It is recommended to upgrade Calderwood Road section between Tripoli Way and eastern boundary to a four-lane road, two in each direction. The profile and cross-section of this road is yet to be determined. It may be desirable to reduce the overall carriageway width on the widened section of Calderwood Road to limit third party land acquisition.

It is also noted that, on the request of Shellharbour Council, Lendlease is currently investigating design options for an interim upgrade of Calderwood Road. Consideration should be given to the ultimate road infrastructure requirements in this area to avoid expensive reconstruction works.

As highlighted in **Section 4.2.4** an appropriate apportionment of costs and funding mechanism (for additional upgrades) should be determined considering the relative benefits to other development sites and the general travelling public.

The updated road hierarchy plan is shown in **Figure 4-21**.

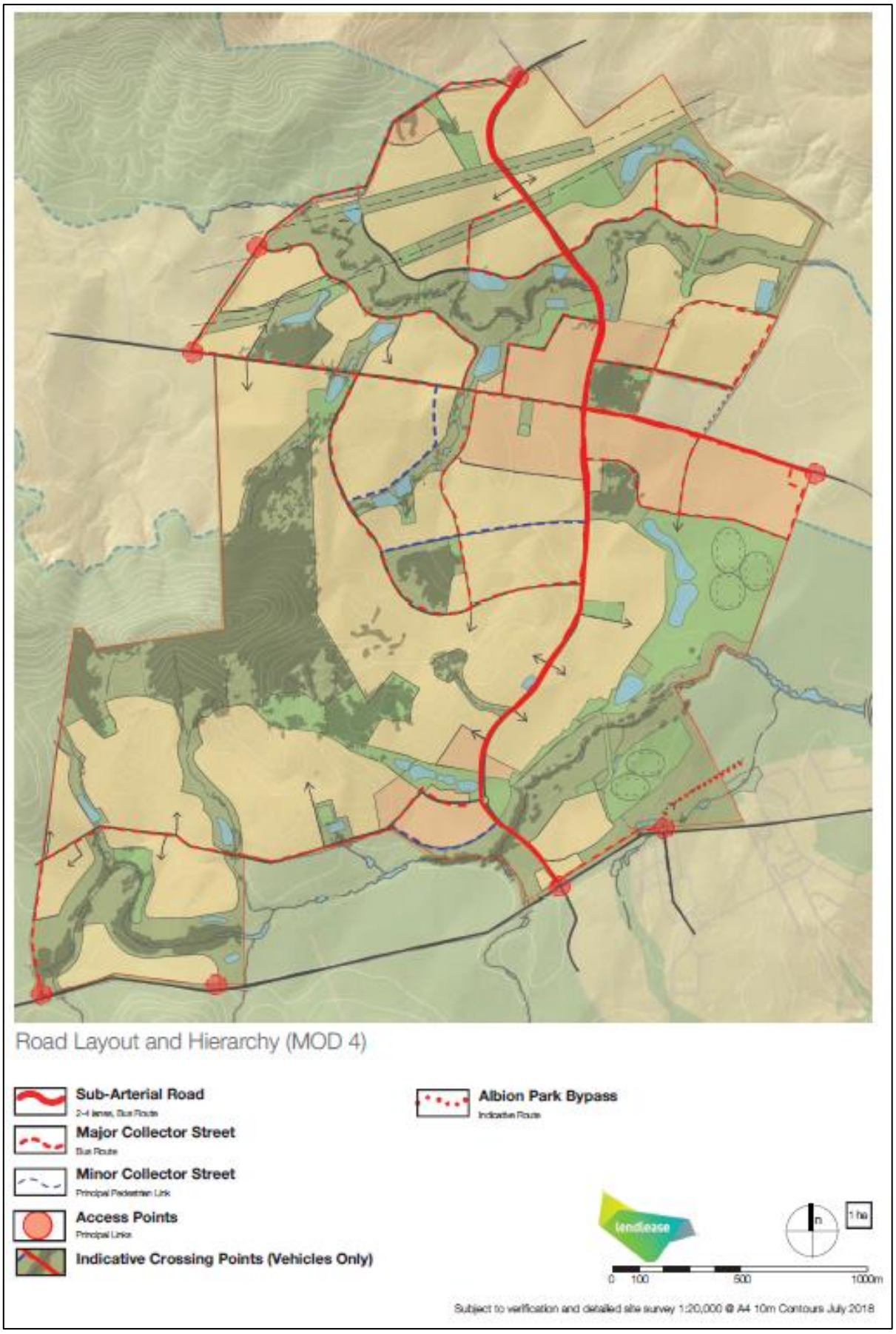


Figure 4-21 Updated Road Layout and Hierarchy Map

Source: Lendlease

4.4.3 Background Review of Parking Measures

The TMAP proposed car parking provision was considered in the Development Control Strategy. However, it was assumed that specific car parking requirements for individual stages will be dealt with at the relevant application stage for residential development.

4.4.3.1 Active Transport Measures (TMAP, 2010)

A wide range of active transport measures was proposed in TMAP (2010) to be implemented to take advantage of the layout and design of the precincts, which would assist in the encouragement and support of active transport for commuting, recreation and other travel needs. The active transport measures that was related to parking provisions are described below:

4.4.3.1.1 Measure 11: Parking Strategies

Parking in the town and village centres will be co-ordinated and where possible shared across uses. This, along with possible time restrictions and extensive on-street parking, will create more walkable centres. The establishment of a shared parking district could also be considered in the town centre to further reduce the parking requirements and to encourage a park once attitude when undertaking multiple activities in the town centre.

4.4.3.2 Public Transport Measures (TMAP, 2010)

Additionally, parking related measures are detailed in the TMAP to promote use of public transport by increasing accessibility to bus stops using non-motorized mode. As per Section 9.5.3 of TMAP (2010), there is a potential to encourage the use of cycling to further increase the catchment of the Strategic Bus Corridor stops through the provision of adequate bicycle parking facilities, particularly in Calderwood town centre and the village centre. Both these locations are well placed for encouraging multi-purpose trips and increasing the catchment of the Strategic Bus Corridor.

It was also proposed in Section 9.5.7 of TMAP (2010) that Bicycle Parking rail may be provided on bus stops in CUDP depending upon the surrounding land uses, frequency of bus services, potential patronage and ranking of the stop. It will not only promote public transport use but also encourage active transport travel choice.

4.4.3.3 Parking Measures in Town Centre (TMAP, 2010)

According to TMAP, the objective to create a town centre is to develop a structure that is accessible to all residents, provide a range of services and facilities to minimise the need to travel elsewhere.

The town centre is expected to have different developments and it was proposed in Section 3.2.4 of TMAP (2010) to explore the opportunity for shared parking options in the detailed design to help facilitate a more walkable and pedestrian friendly centre.

It was also proposed to provide bicycle parking at several locations throughout the town centre to promote active transport mode choice.

4.4.3.4 Parking Measures in Village Centre (TMAP, 2010)

As described in TMAP, a second smaller centre in the form of a village centre will also be established to bring services and amenities closer to the homes of residents and to facilitate in the early delivery of these amenities. Town centre and village centre will be well connected with a range of distinct neighbourhoods.

It was recommended in TMAP to consider a shared parking approach to further enhance the walkability and social interaction the centre will offer.

4.4.3.5 CUDP Parking Measures (Draft DCS)

As described in **Section 4.4.1.3** a comprehensive internal road hierarchy plan was approved for CUDP and detailed design standards are specified in the DCS and are reproduced in **Table 4-10.** The DCS clearly defines the parking requirements for each type of road to be provided in Calderwood.

Additionally, the DCS specifies parking requirement for each form of housing to be provided in CUDP. These parking related controls / requirements for different form of housing are described in **Table 4-11.**

Table 4-11 Parking Controls for Different Forms of Housing

Allotment Type		Parking Requirements	
		Min. Spaces Per Dwelling (#)	Visitors
Standard Residential Allotments	Villa	1	On Street
	Smart Lot	2	On Street
	Courtyard	1	On Street
	Zipper Lots	1	On Street
	Traditional	2	On Street
	Parkland	2	On Street
	Parkland+	2	On Street
Integrated Housing	Attached	1	On Street
	Semi-detached	1	On Street
	Detached	1	On Street
Integrated Housing (TC/VC only)	Town Home	1	On Street
	Urban-Sleeve/Nano	1	On Street
	Live Work	1	On Street
	Shop-Top	1	On Street
	Apartments	1 bed - 1 space 2 bed - 1.5 spaces 3 bed - 2 spaces	1 / 5 dwellings

Source: CUDP Development Control Strategy (JBA, 2018)

4.4.4 Adequacy of Proposed On-Street Parking Provisions

One of the key changes proposed to the internal road network cross sections (as shown in **Table 4-12**) is the reduction in the width of on-street parking lanes from 2.8m to 2.5m on some roads. The reduced parking lane width meets the minimum requirements for parallel parking dimensions as specified in AS2890.5 (On-street parking) Table 2.1.

Table 4-12 Proposed Parking Provisions – Comparison of DCS 2011 and DCS 2018

Street Type		Parking Provisions	
Sub Arterial Road		**DCS 2011**	**DCS 2018**
A1	Sub Arterial with Parking on both sides and bus service	5.6 (2.8 + 2.8)	5.6 (2.8 + 2.8)
A2	Sub Arterial with Median and one-way traffic lanes with parking	5.6 (2.8 + 2.8)	0
A3	Sub Arterial (one lane in each direction with parking bays)	5.6 (2.8 + 2.8)	5 (2.5 + 2.5)
Major Collector Road		**DCS 2011**	**DCS 2018**
B1	Major Collector with parking on both sides and bus service	5.6 (2.8 + 2.8)	5 (2.5 + 2.5)
B2	Major Collector with Median and parking on both sides and bus route	5.6 (2.8 + 2.8)	5 (2.5 + 2.5)
B3	Major Collector adjacent Rural Lands	N/A	5 (2.5 + 2.5)
B4	Major Collector with Median and parking on both sides and bus route	N/A	5 (2.5 + 2.5)
Minor Collector Road		**DCS 2011**	**DCS 2018**
C1	Minor Collector with parking on both sides	5.6 (2.8 + 2.8)	5 (2.5 + 2.5)
C2	Minor Collector - Pedestrian priority Street with parking on both sides and bus route	5.6 (2.8 + 2.8)	5 (2.5 + 2.5)
Town and Village Centre		**DCS 2011**	**DCS 2018**
D1	Town and Village Centre - Collector Road with parking on both sides, fully paved verge and bus route	5.6 (2.8 + 2.8)	5 (2.5 + 2.5)
D2	Town and Village Centre - Access Street with parking on both sides and fully paved verge	5.6 (2.8 + 2.8)	5 (2.5 + 2.5)
D3	Town Centre Main Street – parking both sides and perpendicular parking to open space edge, fully paved verge and bus route	N/A	8.1 (2.5 + 5.6)
Access Streets		**DCS 2011**	**DCS 2018**
E1	Access Street - Town with on street parking and footpath on both sides	On Street	On Street
E2	Access Street - Standard Residential Street with on street parking and footpath on both sides	On Street	On Street
E3	Access Street - Urban One Way with on street parking and footpath on both side	On Street	On Street
E4	Access Street - Urban (Standard Urban Town and Village centre) with on street parking and footpath on one side	On Street	On Street
E5	Access Street - APZ Edge with optional Hike / Bike and footpath on each side	On Street	On Street
E6	Access Street - Country with on street parking and footpath on one side	On Street	On Street
E7	Access Street with WSUD Median parking bays on both sides plus variable width WSUM Median	2.5	2.5
E8	Access Street - Hill Side with variable carriageway width responding to terrain plus passing and parking bays in select locations	2.5	2.5
Miscellaneous		**DCS 2011**	**DCS 2018**

Street Type		Parking Provisions	
F1	Lane	0	0
F2	Open Space Edge Mews (Parking one side, Shared Pedestrian adjacent to open space)	2.5	2.5
F3	Access way - Mews no parking	2.5	0
F4	Access way parking one side	2.5	2.5

4.4.5 Additional Parking Measures

4.4.5.1 Car Parking Measures

4.4.5.1.1 Shared Parking Facilities in Town Centre / Village Centre

Every type of development / land use has a specific parking demand peak period that forms the basis of parking provision guidelines. If a development has a mix of uses (e.g. town centre) there may be an opportunity to utilise common or shared car parking areas, and therefore reduce the overall number of car parking spaces provided. This approach to parking provision would be in accordance with the stated aims of Sustainability Measure 11 (see Section 4.7.1).

Based on feedback from Shellharbour Council, there have been some shared parking trials undertaken as part of town centre developments at Shellharbour City Centre and Shell Cove, with mixed results. Considering the above, it is recommended to maintain shared parking provision as an overall objective for the CUDP, while acknowledging that the details may need to be resolved at a later stage when there is more certainty around specific non-residential land use and likely tenants.

4.4.5.2 Bicycle Parking Measures

- Bicycle parking should comply with Australian Standard, Parking facilities, Part 3: Bicycle parking (AS 2890.3).
- Bicycle parking should be provided for residential and non-residential land use, in accordance with relevant DCP / DCS controls.

4.4.6 Conclusions

- The overall internal road network is in accordance with approved road hierarchy plan of CUDP
- There are minor changes in the alignment of the streets that has evolved with the passage of time and development in CUDP
- The change in the internal road network plan of CUDP is continuous east-west alignment of Calderwood Road within the CUDP and its connection with other roads
- A detailed traffic assessment will be submitted with the relevant application for each subdivision and infrastructure works for each future stage of the project as currently required by Condition C5 of the Concept Plan approval, with regard to:
  - Traffic generated by that particular stage of the development
  - Existing capacity of surrounding road network and its ability to accommodate the development proposed within the Stage
  - Identification of upgrades to any external local roads required to accommodate that stage
- Detailed design plans for the proposed road works to be undertaken as part of each Stage are to be submitted with the relevant application for subdivision and infrastructure works, including:
  - Plans for the external road network upgrades to be undertaken as works in kind including details of proposed timing / staging for the completion of the works
  - Plans for proposed internal road and parking arrangements, including number of parking spaces required to meet the demand generated by the development proposed.

4.5 Sears Part 5: Pedestrian / Cyclist connectivity

The pedestrian and cyclist connectivity includes the assessment of the existing background documentation include the Calderwood Transport Management and Accessibility Plan (TMAP) and Calderwood Development Control Strategy (DCS). Using this background documentation and assessment of the yield increase, an updated active transport network is provided to cater for the increase in number of dwellings.

4.5.1 Background review

4.5.1.1 Calderwood Transport Management and Accessibility Plan (2010)

The TMAP recommends how the impact of all modes of transport could be managed because of changing developments within the region.

The TMAP provides a number of active transport principles to encourage and support active transport for commuting, recreation and travel. Principles related to active transport are as follows:

- Local access street design – provision of traffic calming, signage, pavement designs that encourage pedestrian priority
- Pedestrian and cycle hierarchy – provide links to key amenities including open spaces, schools, town and village centres. The path network includes linkage corridors and aside collector and arterial roads
- Wayfinding signage – provide signage to indicate access routes to key amenities. This signage should include the provision of distances, times and accessibility
- Parking strategies – creation of walkable centres by providing time restrictions, and on-street parking
- Safety elements for network – Crime Prevention through Environmental Design (CPTED) will be applied to all paths, with the inclusion of lit paths to encourage use after dark. Other amenities can be provided including seats, bike racks and shade structures
- Bicycle parking – should be provided in close proximity to key amenities including schools, ovals, town and village centres.

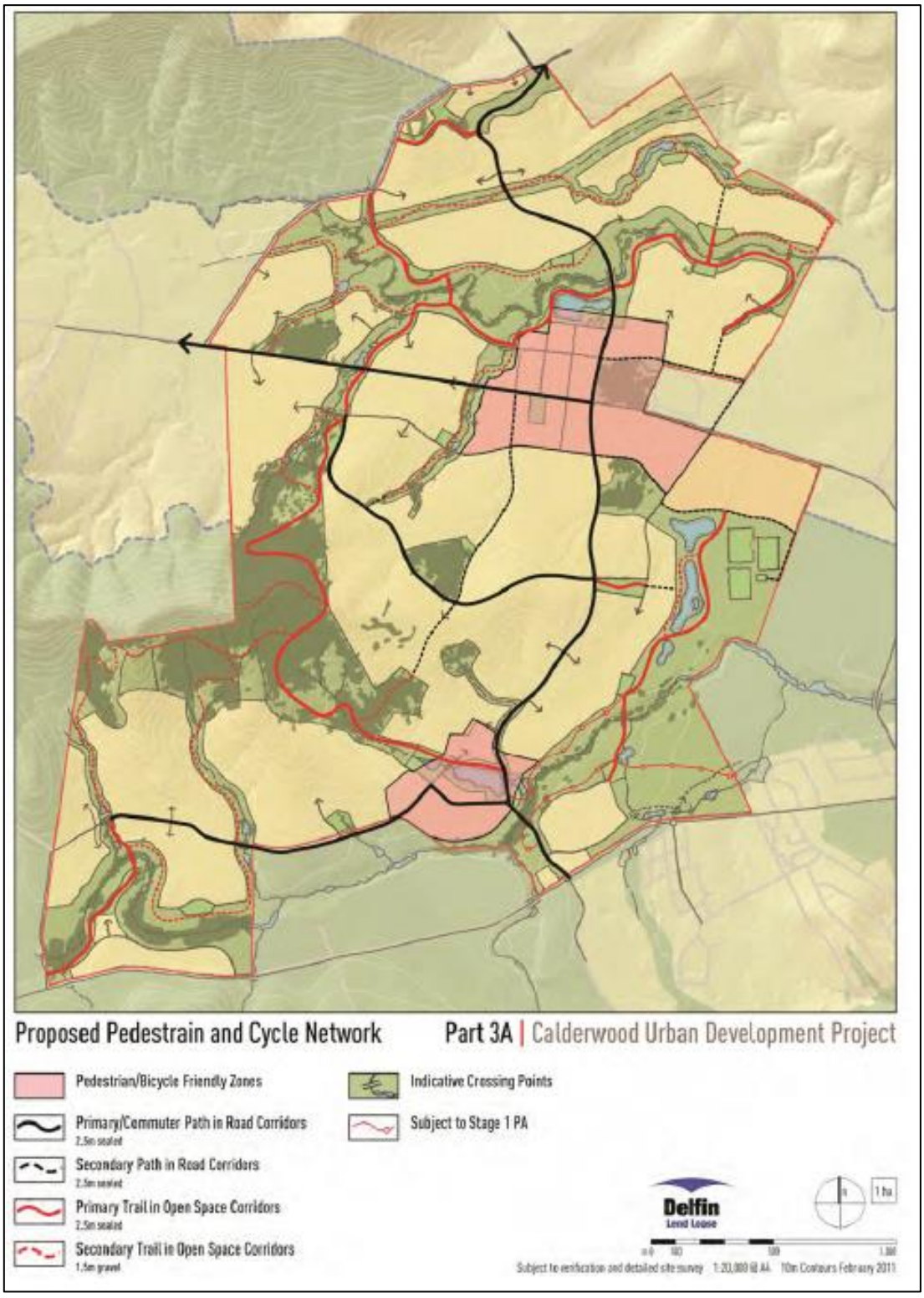


Figure 4-22 Approved Pedestrian and Cycle Network

Source: Consolidated Concept Plan (JBA, 2011).

4.5.1.2 Calderwood Draft Development Control Strategy

In accordance with the DCS, footpaths should be provided on all roads within the CUDP. There is however an exception where terrain limits this provision.

The footpaths widths and on-road cycle lanes required are extracted from the DCS and shown in **Table 4-13.**

Table 4-13 Footpaths widths required

Street Type		On - Street Cycle Lanes	Footpath
Sub Arterial Road	A1	0	1.5 metre and 2.5 metre
	A2	0	1.5 metre and 2.5 metre
	A3	0	1.5 metre and 2.5 metre
Major Collector Road	B1	0	1.5 metre and 2.5 metre
	B2	0	1.5 metre and 2.5 metre
	B3	0	2.5 metre on one side
	B4	0	1.5 metre and 2.5 metre
Minor Collector Road	C1	0	1.5 metre on both sides
	C2	0	1.5 metre and 2.5 metre
Town and Village Centre	D1	0	5 metre on both sides
	D2	0	4 metre on both sides
	D3	0	2.5 metre and 5 metre
Access Streets	E1	0	1.5 metre on both sides
	E2	0	1.5m, on one side
	E3	0	1.2 metre on both sides
	E4	0	1.5m, on one side
	E5	0	1.5m, on one side
	E6	0	1.5m, on one side
	E7	0	1.5m, on each side
	E8	0	N/A
Miscellaneous	F1	N/A	N/A
	F2	N/A	Shared Way
	F3	N/A	Shared Way
	F4	N/A	Shared Way

Source: CUDP Development Control Strategy (Ethos Urban, 2018)

4.5.2 Proposed network

4.5.2.1 Pedestrian network

All of the priority pedestrian paths are proposed to be a minimum 1.5 metres wide, with the town and village access collector roads being five and four metres wide respectively. These footpaths have been deemed adequate to cater for volumes in excess of likely flows.

Pedestrian priority routes ensure key linkages have been catered for. The majority of these are to provide direct access to key land uses as well as the proposed bus stops. The bus stop locations have been discussed in detail in the **Section 4.6**.

Access roads propose a minimum 1.2-metre-wide footpath on at least one side of the road.

A map of the potential pedestrian network is shown in **Figure 4-23**. The primary and secondary cycle trails have been included in this map as these are likely be shared paths that would also provide pedestrian access.

The proposed path widths align with recommendations in Austroads.

4.5.2.2 Cycling network

The shared path network is proposed to link with the regional cycle network along Marshall Mount Road indicated in the West Dapto Urban Release Area Plans. It is recommended that each shared path provide a minimum 2.5 metres wide path along each route.

A map of the potential cycling network is shown in **Figure 4-23.**

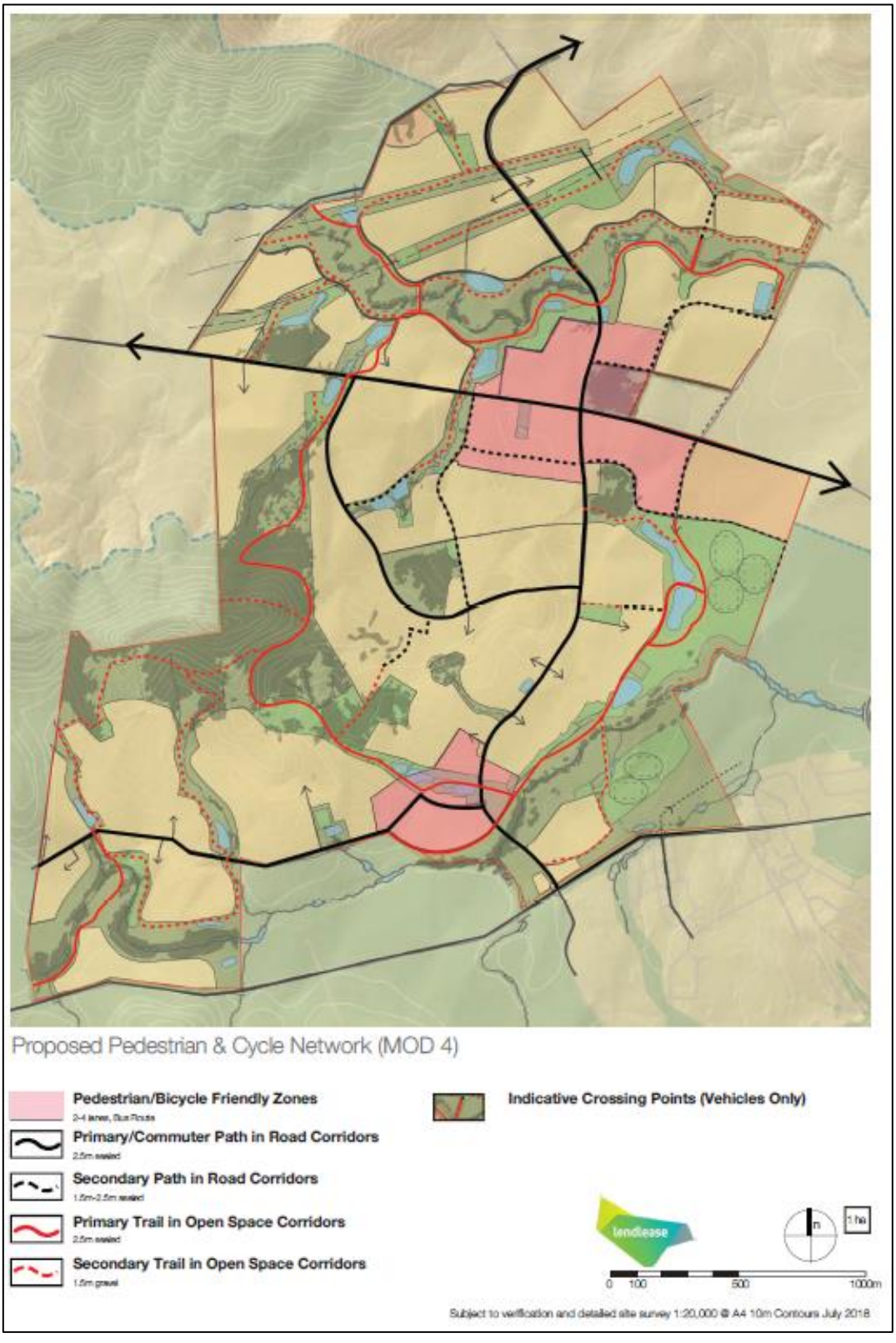


Figure 4-23 Proposed Pedestrian and Cycle Network

Source: Lendlease.

The on-going shared way development in the CUDP is in line with the proposed pedestrian and cycle network, shown in **Figure 4-23**. For example, the constructed part of the Escarpment Drive in the CUDP includes a shared way, illustrated in **Figure 4-24.**

Figure 4-24 Shared Way on Escarpment Drive

Source: Nearmap and Lendlease

4.5.3 Access to public transport

The footpath network must provide access to all bus stops within the CUDP. Bus stops and formal pedestrian crossings should be co-located. Formal pedestrian crossings could include pedestrian refuges, pedestrian crossings and signalised pedestrian crossings. The form of crossing should occur during the detailed design phase.

4.5.4 Review of measures to maintain road and personal safety in line with Crime Prevention Through Environmental Design (CPTED) principles

4.5.4.1 Crime Prevention through Environmental Design (CPTED)

CPTED is defined as follows by the NSW Police.

CPTED is a crime prevention strategy that focuses on the planning, design and structure of cities and neighbourhoods. It reduces opportunities for crime by using design and place management principles that reduce the likelihood of essential crime ingredients (law, offender, victim or target, opportunity) from intersecting in time and space.

Predatory offenders often make cost-benefit assessment of potential victims and locations before committing crime. CPTED aims to create the reality (or perception) that the costs of committing crime are greater than the likely benefits. This is achieved by creating environmental and social conditions that:

- *Maximise risk to offenders (increasing the likelihood of detection, challenge and apprehension).*
- *Maximise the effort required to commit crime (increasing the time, energy and resources required to commit crime).*
- *Minimise the actual and perceived benefits of crime (removing, minimising or concealing crime attractors and rewards).*
- *Minimise excuse making opportunities (removing conditions that encourage/facilitate rationalisation of inappropriate behaviour).*

4.5.4.2 Surveillance

There are a number of principles that reinforce CPTED, including natural surveillance, natural access control and natural territorial reinforcement. Natural surveillance is most important when considering new pedestrian and cycling facilities.

Surveillance relates to designing infrastructure that helps increase visibility for pedestrians and cyclists. Key designs outcomes would include:

- Lighting should be provided such that it is located below the tree canopy, to reduce shadows.
- View lines should be maximised along routes from streets.
- Along the pedestrian/ cyclist shortcuts, the pathways should be wide, with fences to properties provided as low as possible. Windows should be placed overlooking these pathways.
- Within the mixed-use precinct, retail or food land uses should be provided on the ground level to enhance surveillance, activity and amenity.

With the increase in yield within the study area, there will be increased movements to and through the CUDP that will increase passive surveillance.

4.5.4.3 Road Safety

It is important that adequate crossing points and infrastructure are provided to ensure pedestrian's safety. Roads and Maritime warrants assessment should be completed during detailed design of the road network for the CUDP to assess the crossing facilities / infrastructure required. This infrastructure includes the following:

4.5.4.3.1 Pedestrian Refuges

Pedestrian refuges allow pedestrians to cross one direction of vehicle traffic at a time, providing a safe place in the middle of the road carriageway to wait before completing the second leg of the road crossing. Splitter islands provide a similar amenity, however are located on roundabout approaches.

Pedestrian refuges should be designed in accordance with AS 1742.10-2009 with reference to Roads and Maritime supplement and TDT 2011/01a. They should be designed 3.0 metres parallel to the road direction of travel (minimum), and 2.0 metres perpendicular to the road direction of travel (minimum).

4.5.4.3.2 Signalised Pedestrian Crossings

Signalised pedestrian crossings provide pedestrians with a green traffic light signal priority to cross a street.

Signalised pedestrian crossings should be designed in accordance to AS 1742.10-2009 Pedestrian control and protection with reference to Roads and Maritime supplement and TDT 2002/12c (Stopping and Parking restrictions at intersections and crossings). Key design criteria include the provision of an audio indicator, pedestrian lantern and minimum 3.3 metre delineated crossing width.

4.5.4.3.3 Zebra and Raised Zebra Crossings

Zebra crossings provide pedestrians with prioritised road crossing opportunities; vehicles must give way to pedestrians who are walking across a zebra crossing.

Zebra and raised pedestrian crossings should be designed in accordance with AS 1742.10-2009 Pedestrian control and protection with reference to Roads and Maritime supplement and TDT 2001/04b (Traffic calming devices such as pedestrian crossings). Key design standards include delineated crossing width of 3.6 metres, provision of good sightlines, lighting, signage and line marking.

4.5.4.3.4 Kerb Ramps

Kerb ramps are used to assist pedestrians, particularly those who are less mobile, to enter and exit the roadway safely to cross the street at a designated point.

Kerb ramps should be designed in accordance to AS1428.1-2009 and AS1428.4.1 – 2009 Design for Access and Mobility, and Roads and Maritime Standard Drawing R0300-11. Kerb ramp widths should correlate to the width of the adjoining footpath. For instance, if the kerb ramp joins to a 1.5 metre footpath, a 1.5-metre-wide kerb ramp should be provided.

At each intersection, kerb ramps should be provided at each pedestrian approach. Examples include:

- Every intersection with four approaching roads should have eight kerb ramps provided; two on each corner
- Every T-junction should be provided with six kerb ramps.

4.5.5 Conclusions

- Potential pedestrian network has been proposed with:
  - 1.2-metre-wide footpath on at least one side of access roads.
  - 1.5-metre-wide pedestrian priority paths
  - 5 metre and 4-metre-wide pedestrian paths on collector roads around town centre and village centre respectively
- Potential cycling network has been proposed with following key features:
  - Shared paths proposed in a bid to encourage cycling within the CUDP, to the surrounds and for through trips
  - Proposed shared paths link with the regional cycle network along Marshall Mount Road indicated in the West Dapto Urban Release Area Plans
- It is recommended that each shared path provide a minimum 2.5 metres wide path along each route
- It is also recommended to footpath access should be provided to all bus stops along with formal pedestrian crossings.
- CPTED principles will be incorporated in the urban design to ensure personal and road safety for CUDP residents.

4.6 Sears Part 6: Public Transport Assessment

4.6.1 Background review

4.6.1.1 Integrated Public Transport Service Planning Guidelines – Outer Metropolitan Area (2016)

The Integrated Public Transport Service Planning Guideline's developed by Transport for NSW (TfNSW) in 2016 provides a guideline for developing a public transport network. It is based upon five key principles that are:

- Provide positive customer experience
- Consider government policy
- Develop an integrated public transport network
- Plan for efficient asset and infrastructure usage and operation
- Foster continuous improvement.

In addition to the five key principles, there for four key baseline indicators that must be assessed that are; capacity, coverage, service provision and performance.

The key guidelines for the concept design of bus routes are as follows:

- Bus services should be provided within a 400 metre distance (as the crow flies) to 90 percent of households
- Routes should be designed so they provide a reasonably direct journey for the majority of customers

- Customers should be taken as close as possible to their destination
- Interchanges are identified with opportunities to interchange between services.

These guidelines are adopted in the development of a potential network.

4.6.1.2 Calderwood Transport Management and Accessibility Plan (2010)

The Calderwood TMAP, developed in 2010, provides a concept plan for the public transport network in a bid to reach a sustainability target of ten percent mode shift away from private vehicles. Journey to Work Census data 2006 for Wollongong and Shellharbour LGA's, indicated that car based travel represented 90 percent of all trips.

The TMAP provides a concept plan for the bus network and proposed bus stop locations based on the 2010 yield estimates. This concept plan was based upon the key measures for public transport that are as follows:

- Bus network provision – to be coordinated with TfNSW and Premier Illawarra approximately 12 months prior to inhabitation
- Services levels that meet and exceed TfNSW Outer Metropolitan Service Planning Guidelines
- Early bus service provision – to be completed in corroboration with TfNSW
- Branding and publicity – provide uniform branding and information for residents
- Bus stop infrastructure – provide DDA compliant assess to bus stops which includes crossing facilities and potential shelters
- Bus network infrastructure – provision adequate bus priority where required.

The indicative bus network approved as part of the CUDP Concept Plan (2010) is shown in **Figure 4-25**. This network is based upon a key strategic trunk route with feeder / local bus services servicing the remainder of the CUDP.

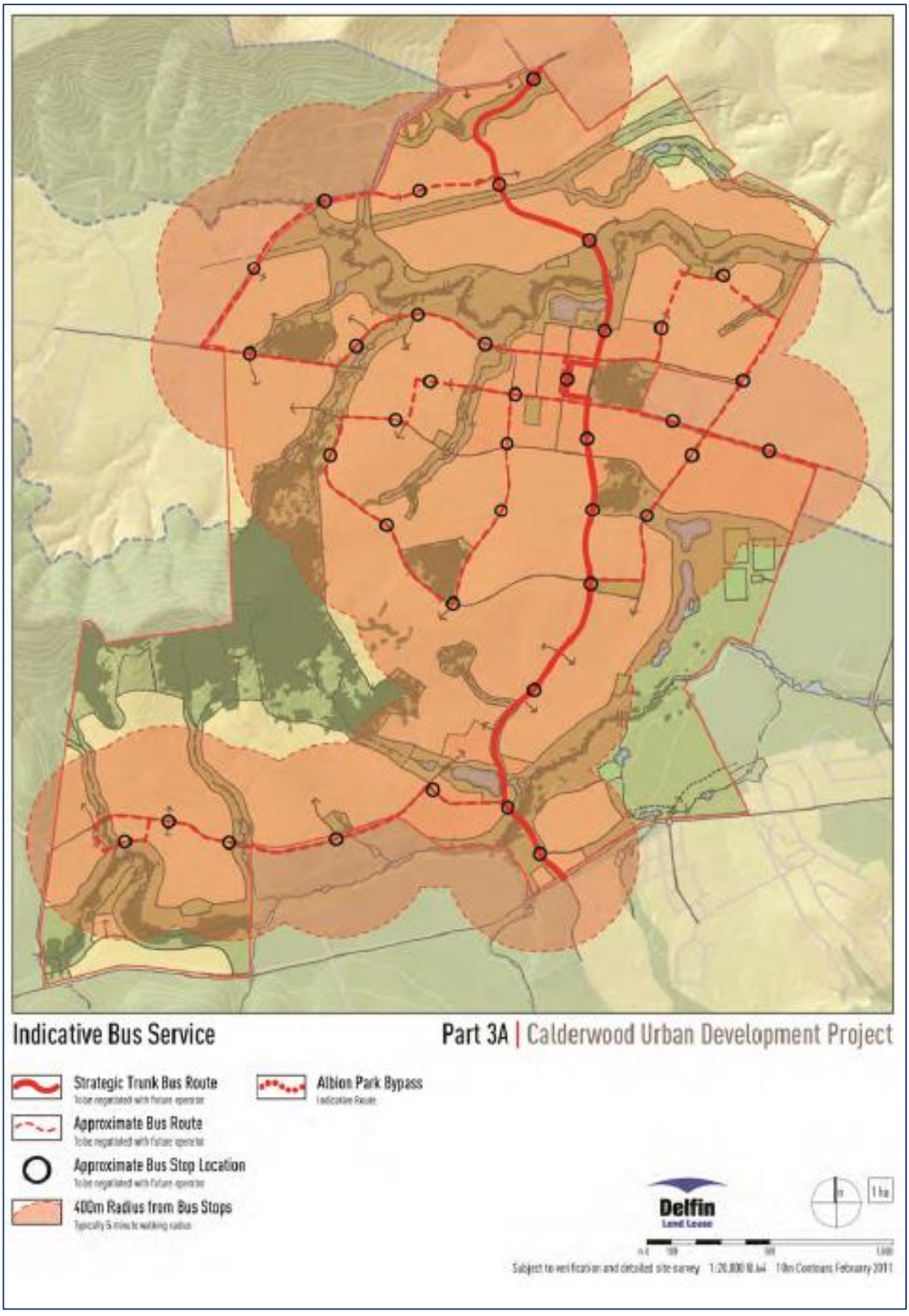


Figure 4-25 Formerly Proposed Bus Network

Source: Consolidated Concept Plan (JBA, 2011).

4.6.2 CUDP TMAP Bus Network

The formerly proposed bus network provides a strategic route that proposed regional connections to the rail network and key regional centres. The key trunk route however provides a deviation at the town centre that has the potential to delay services as well as reducing the directness of the bus service. The strategic route operates as the spine of the network, supported by local / feeder routes.

The formerly proposed local bus services provide a loop service through the CUDP. These support local trips and interchange with the strategic bus route.

4.6.3 Bus Network Case Studies

The concept of strategic bus routes supported by feeder/ local services is well established in Australia and around the world, although more challenging in a semi-rural setting. Examples of this exist in New South Wales (Northern Beaches) and Australian Capital Territory (Canberra). These are summarised in the following sections.

4.6.3.1 Northern Beaches B-Line

Transport for NSW introduced the Northern Beaches “B-line” bus services in late 2017. B-Line services provide limited express stops at ten key town centres between Mona Vale and the Sydney CBD. Services run between 4:30am and 12:30am, seven days a week. These bus services are high frequency and reliable due to bus priority measures that have been put into place.

The implementation of the B-Line included the redesign of the existing bus network to discontinue redundant services and reallocate some services to feed into the B-Line network as well as service local trips.

The feeder bus services have been further complimented with the trial on-demand bus services (discussed in **Section 4.6.6.2**).

4.6.3.2 Canberra Bus Network

The Canberra bus network also provides a similar bus to bus strategy, with nine rapid routes providing commuters access to regional destinations, and local bus services feeding into this network. The purpose of Canberra’s rapid bus routes is to provide higher frequency, direct and quicker trips between town centres. These rapid bus routes will be integrated with the New Light Rail line and operates seven days a week during both peak and off-peak periods.

4.6.4 Existing Bus Service in Calderwood

Calderwood is currently serviced by the Route 75 bus service operating between Shellharbour City Centre and Calderwood. In the suburb of Albion Park Route 75 operates as a one-way clockwise loop service calling at Albion Park town centre, Exeter Place (Tullimbar Public School) and Calderwood.

The route provides four services between 05:00 and 09:00 at approximately hourly intervals and five services in the afternoon and evening between 15:30 and 20:30 at hourly intervals. During the non-peak hours, there are five services operating at hourly intervals. No services are provided at weekends and public holidays (See **Table 4-14**).

This bus service currently connects surrounding suburbs of Albion Park, Calderwood and Tullimbar to Shellharbour City Centre and Oak Flats train station. The Premier Illawarra Route 75 is shown in **Figure 4-26**.

Table 4-14 Bus Route 75 Timetable

Timetable – Premier Illawarra Route 75 (Shellharbour City Centre to Calderwood)																
Map Ref	**Location / Stop**	**Arrival Time**														
A	Stockland Shellharbour	05:27	06:38	07:21	08:21	10:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:23
B	Oak Flats Station	05:33	06:45	07:28	08:28	10:07	12:07	13:07	14:07	15:07	16:07	17:07	18:07	19:07	20:07	21:30
C	Tongarra Rd after Russell St	05:41	06:55	07:38	08:38	10:17	12:17	13:17	14:17	15:17	16:17	17:17	18:17	19:17	20:17	21:40
D	Tullimbar Village	05:45	07:00	07:43	08:43	10:22	12:22	13:22	14:22	15:22	16:22	17:22	18:22	19:22	20:22	21:45
E	North Macquarie & Calderwood	05:53	07:08	07:51	08:51	10:30	12:30	13:30	14:30	15:30	16:30	17:30	18:30	19:30	20:30	21:53
F	Tongarra Rd after Terry St	06:00	07:15	07:58	08:58	10:37	12:37	13:37	14:37	15:37	16:37	17:37	18:37	19:37	20:37	22:00
B	Oak Flats Station	06:10	07:25	08:08	09:08	10:47	12:47	13:47	14:47	15:47	16:47	17:47	18:47	19:47	20:47	22:10
A	Stockland Shellharbour	06:17	07:32	08:15	09:15	10:54	12:54	13:54	14:54	15:54	16:54	17:54	18:54	19:54	20:54	22:17

Source: http://www.premierillawarra.com.au/pdf/timetables/75.pdf , viewed on 10 July 2018.

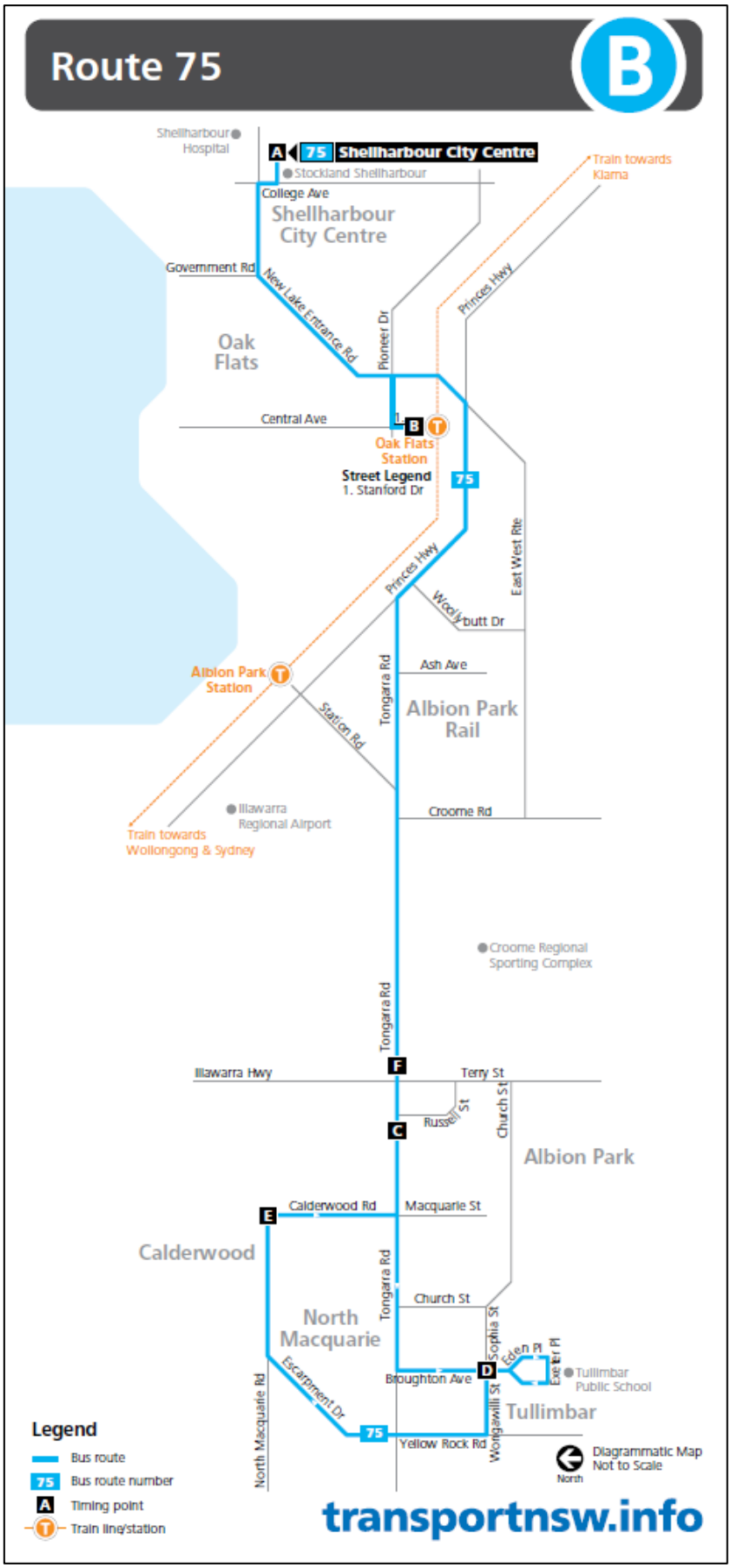


Figure 4-26 Existing Bus Route 75

Source: http://www.premierillawarra.com.au/pdf/timetables/75.pdf , viewed on 10 July 2018.

4.6.5 Short Term Public Transport Plan

It is anticipated that the existing Route 75 will continue to service the CUDP in its current form for the foreseeable future, with the possible addition of weekend services as demand increases. The route map for the 75 service is shown in **Figure 4-26.** As successive stages of the CUDP are developed, there may be opportunities for minor adjustments to the Route 75 to keep pace with the expanding residential population.

4.6.6 Long Term Public Transport Plan

The previous recommendations of the 2010 TMAP are considered an appropriate strategy for long term bus service provision in Calderwood. Minor changes are required to fit within the revised road layout, however the north-south trunk bus route remains a key feature of the long term proposed bus network. This would adequately serve the region subject to appropriate frequency, temporal service span and trip time.

The trunk bus route should link with Albion Park or Oak Flats Station to the south and Dapto Station or the proposed Penrose Station to the north. It should include other existing and proposed future town centres of Avondale, Cleveland and Dapto. The concept plan for the strategic bus route is shown in **Figure 4-27.**

Within the CUDP, the main trunk line would run along the key north-south sub-arterial road, Escarpment Drive, with a bus stop at Calderwood town centre. The feeder services would provide a local bus service throughout the CUDP, with the existing Route 75 providing services to Oak Flats Station. It is recommended that Route 75 be deviated to ensure it runs to Calderwood town centre bus interchange, and no longer operate as a one-way loop service through Calderwood.

The proposed bus stops have been placed along the local / feeder bus routes, in line with TfNSW guidelines and to help ensure that most residents are located within 400 metres of a bus stop. These bus stops have been located as close as possible to key land uses, and close to key intersections. It is proposed that the strategic trunk bus route has limited stops.

A concept plan of the proposed network, bus stops and 400 metre bus stop catchments is shown in **Figure 4-28.**

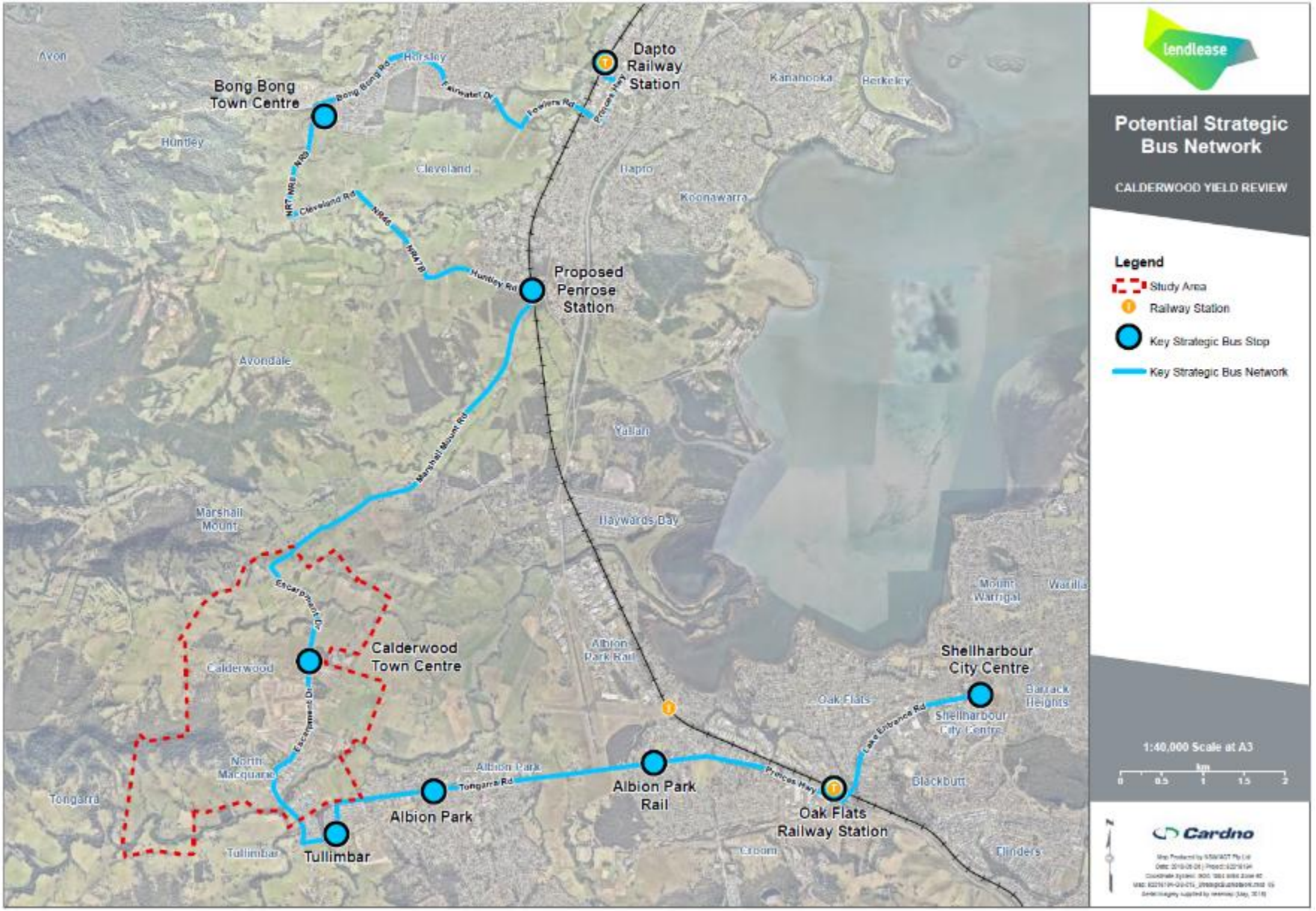


Figure 4-27 Potential Strategic Bus Network

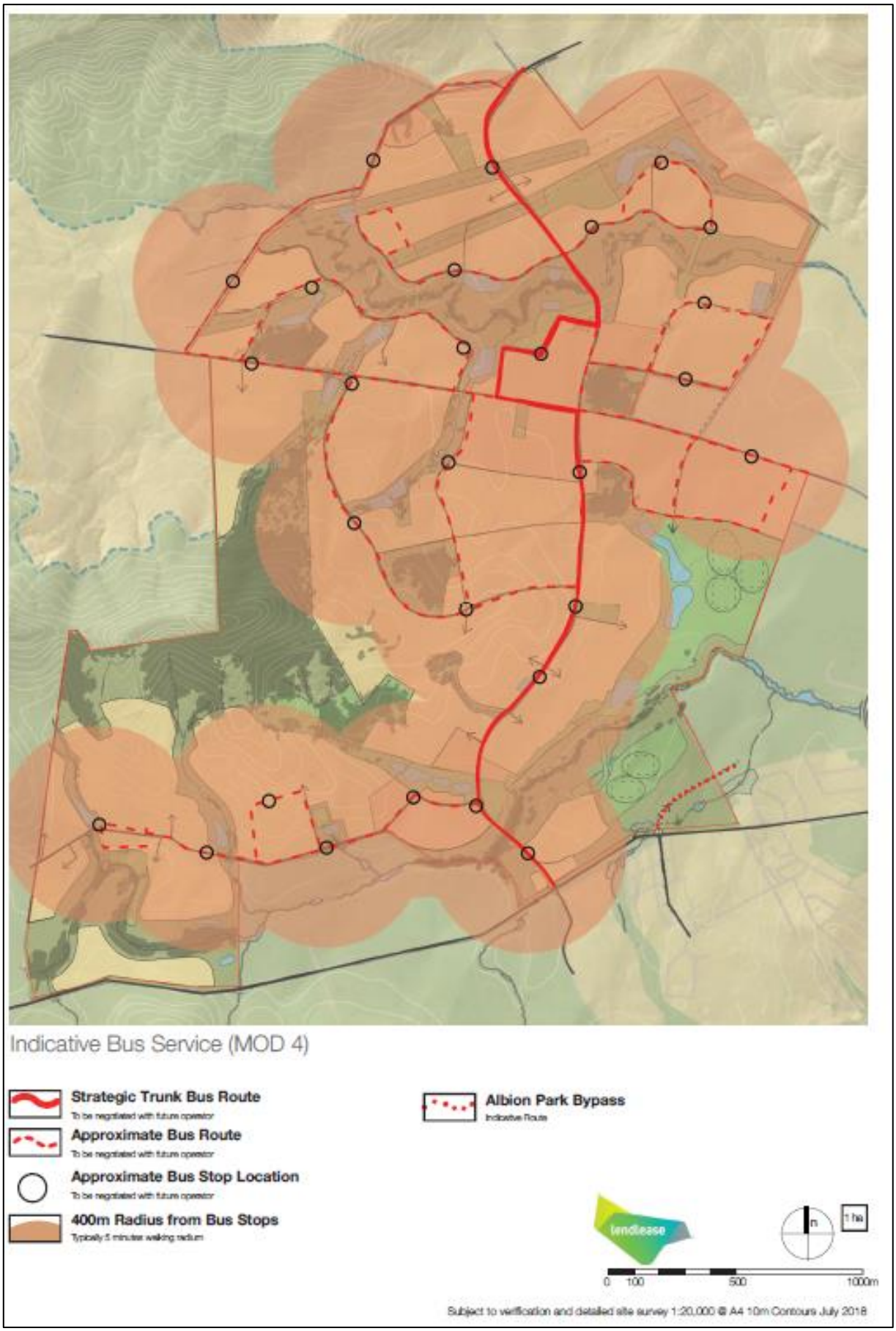


Figure 4-28 Proposed Indicative Bus Service (Mod 4)

Source: Lendlease

4.6.6.2 On Demand Bus Services

There is the potential for the local bus network to be run as on-demand services, which is currently being trialled in Sydney and Newcastle.

On-demand public transport allows someone to book a bus service from a nearby location and take them to a transport hub or key land use. This can provide the user with flexibility, and provide a more convenient public transport trip.

The key interchange for the Precinct would be next to the town centre, as well as a smaller interchange at the village centre. Each of the bus services could run on this dedicated route with stops at the key land uses. These interchange points could be used by customers to travel to regional destinations.

With the increase in yield for the CUDP, it is important that service frequency on both the local services and strategic network is adequate and in line with the integrated public transport planning guidelines.

4.6.7 Adequacy of Public Transport Services

As described in **Table 3-2**, the proposed yield increase in the CUDP will generate approximately 987 additional public transport trips in a day and 99 additional trips in the peak hour. The proposed short term (**Section 4.6.5**) and long term (**Section 4.6.6**) public transport plan is considered adequate to accommodate the above-mentioned increase in public transport demand.

4.6.8 Pedestrian and Cyclist Access to Public Transport

A pedestrian and cycle network is proposed in **Section 4.5.2** and illustrated in **Figure 4-23**. The proposed pedestrian and cycle network is complementary to the proposed CUDP bus network (see **Figure 4-28)**, connecting residential areas with their nearest bus stop via a network of active travel routes.

It is important that adequate bicycle parking is provided at bus stops to facilitate cycle-bus interchange.

4.6.9 Conclusions

- In line with vision of Future Transport Strategy 2056 following recommendations have been made:
  - Premier Illawarra Bus Route 75 will continue to provide a loop service linking Calderwood to Shellharbour City Centre, with minor adjustments anticipated in the short term as the CUDP evolves.
  - A strategic bus route has been proposed as part of the long term public transport plan to connect CUDP development with Shellharbour and Dapto. Additionally, a local bus network and amended 75 route has been proposed to facilitate CUDP development.
  - Better public transport connections along with recommendation to ensure service frequency to encourage active travel and public transport usage.
  - Pedestrian and Cyclist provisions at bus stops to encourage walking and cycling in the area.
  - Infrastructure provision that allow access to people with disability / limited mobility.
- Proposed on demand bus service will also reduce private car usage and will promote platoon travelling.

4.7 Sears Part 7: Sustainable Travel Choices

The existing principles in relation to travel demand management, active and public transport usage from the TMAP have been reassessed with consideration of any initiatives implemented since the document was prepared. The key purpose of sustainable travel choices is to ensure a ten percent mode shift, presumably from private vehicles as outlined in item 23 of the revised Statement of Commitment.

4.7.1 Existing Principles

The existing TMAP provides a number of general principles related to travel demand management, active transport and public transport. These principles were developed to encourage sustainability throughout the CUDP.

Table 4-15 summarises the existing sustainable travel principles and outlines additional measures to promote sustainable travel choices which support the achievement of State targets.

Table 4-15 Sustainable Travel Choice Principles

Sustainability measures	Calderwood Urban Development Project Concept Plan TMAP 2010	Commentary
Travel demand management		
Measure 1: Timely provision of facilities and services	Timely provision of facilities for the Calderwood Urban Development Precinct (CUDP) - including community, retail, learning, employment and recreation facilities. The delivery of these essential services and facilities early in the life of the project ensures that residents have access to services and facilities when they need them, thus establishing a more sustainable walking, cycling and public transport usage behaviour for residents.	▪ Active transport facilities should be provided prior to residents moving in to encourage the uptake of active transport within the Precinct.
Measure 2: Fibre to the home and national broadband network	Incorporate Fibre to the Home (FttH) in the delivery of homes to provide opportunities for residents to work from home and facilitate communication between businesses without needing to travel outside the development. Consistent with the principles of the national broadband network.	▪ Installation of high speed fibre network has commenced. High speed internet access is provided to the developed houses that would enable residents to reduce their need to travel. Benefits could include working from home. WIFI facility is also provided at selected public spaces.
Measure 3: Website/ community portal	Establish community website/portal to facilitate promotion of public transport information, initiatives, events and activities for residents and workers. The website could provide links to local service providers as appropriate.	▪ A community website portal could be developed to provide information on sustainable travel, initiatives, promotions and events for the Precinct ▪ Residents are continually updated via electronic direct mail, website news page, Facebook and Instagram. ▪ The website could provide links to key transport apps including trip view and bike hire apps. ▪ This website or social media site could also be used to advertise local businesses and service providers.
Measure 4: Resident kits	Incorporate public transport information, including public transport route maps and timetables, hike and bike trail maps, fitness trail maps and sustainable community initiatives as part of Resident Kits. Sustainable community initiatives to be investigated may include carpooling, bike pooling, bike hire schemes, etc. as appropriate. Kits are distributed to households as they move into the development.	▪ Residents are now provided with general information in their settlement letters. Residents are continually updated via electronic direct mail, website news page, Facebook and Instagram. ▪ Information can include sustainable initiatives such as sustainable transport, potential carpooling, bike hire etc.
Measure 5: Promotions	Promotion of public transport initiatives via Community Portal, Resident Kits, Community Events and Activities. Promotion of significant relevant sustainable transport events e.g. ‘cycle to work’ day.	▪ Promotion of sustainable transport initiatives and events could be provided on the website and resident letters. These events could include cycle to work day, walk safely to school day etc.
Measure 6: Public transport incentives	Investigate with State Government and local transport providers (Premier Illawarra) public transport incentive schemes to encourage resident and worker take up of public transport.	▪ Early delivery of local bus service has occurred with the commencement of bus service 75.
Measure 7: Land use/ transport interactions	A mixed-use approach to all areas of the project built within a street and pedestrian framework based on a modified grid. The following key elements support this measure:	▪ The proposed active transport network would provide comprehensive access throughout the development area and to the surrounds.

Sustainability measures	Calderwood Urban Development Project Concept Plan TMAP 2010	Commentary
	▪ Walking and cycling networks designed to provide for both commuter and recreation users linking key amenities within the Calderwood project as well as providing access to existing neighbouring facilities. ▪ A diversity of land uses and housing types across the project to accommodate a diverse population. ▪ Engaging and active streets that provide a positive experience for the users particularly along primary pedestrian and cycle corridors. ▪ Crime Prevention through Environmental Design (CPTED) principles applied to provide a greater sense of safety through passive surveillance of streets, parks and other areas of open space. ▪ Establish a sub network of lit paths to provide for safer walking and cycling after dark. ▪ Locate key amenities to maximise walkable access. ▪ Holistic approach to the design of the street network, carefully balancing the needs for vehicle movement with the needs of pedestrians and cyclists. This has to be considered at all levels of the design from parking requirements and intersection function down to the detail of path materials and kerb radii to ensure the whole movement system supports a balanced approach.	▪ A cycle network should be provided that does not rely on on-road links to less confident users, particularly children, so they can travel more safely throughout the Precinct. ▪ Each of the key pedestrian and cycle routes should be designed in line with CPTED principles to encourage walking and cycling at all times of the day. This may include the implementation of adequate lighting along these paths.
Active Transport Principles		
Measure 8: Local access street design	A holistic approach will be taken to balance all users of the local streets and will include sufficient space to provide a high level of pedestrian amenity. This will include appropriate pavement designs, traffic calming, signage and speed limits as well as built-form controls on adjacent parcels to create a cohesive and robust environment. On some streets with high pedestrian volumes, further measures will be incorporated to enhance the pedestrian environment through the landscape treatment, driveway access controls and other measures to encourage pedestrian priority.	▪ As far as is practical (due to topographical constraints), the local pedestrian network should comply with Australian Standard Design for access and mobility, Part 1: General requirements for access – New building work (AS 1428.1). A key principal of this would be to provide step free access throughout the development. ▪ Providing local streets with a high level of pedestrian amenity is key to increasing active transport mode share throughout the Precinct. ▪ To encourage cycling as a commuting form throughout the Precinct, provision of facilities that provide access to more users. Currently the key sub-arterial road (north-south road) provides a shared path. ▪ Traffic calming measures could also be provided, which could include speed humps, decreased speed limits and raised pedestrian crossings in high pedestrian activity locations. ▪ Consideration should be given to lower speed limits to reduce speed differential between pedestrians, cyclists and vehicles
Measure 9: Pedestrian and cycle hierarchy	The network established for Calderwood will link all areas of the project with key amenities including open spaces, schools and the facilities in the town and village centres. A hierarchy of paths will be used to create	▪ A pedestrian and cycle concept network plan has been developed. ▪ All paths should be designed to the CPTED principles.

Sustainability measures	Calderwood Urban Development Project Concept Plan TMAP 2010	Commentary
	enhanced corridors providing a greater level of amenity for both pedestrians and cyclists. The path network will make extensive use of the open space areas, linkage corridors (including the linear riparian corridors), collector and arterial roads, and pedestrian priority streets. After dark usage will also be facilitated on key paths to further encourage the safe usage of this network.	
Measure 10: Wayfinding signage	The way-finding strategy will be designed to complement the interpretive strategy and will be implemented progressively as the project is built. The signage needs to indicate access routes for the amenities in the project as well as facilities in neighbouring areas. The signage system needs to be clear and co-ordinated and present information on distances, times and accessibility where relevant.	▪ Signage and wayfinding for pedestrians and cyclists is important, and should provide information on the key access routes, distance and/or time to key land uses as well as accessible paths. These are to be provided at key decision points.
Measure 11: Parking strategies	Parking in the town and village centres will be co-ordinated and where possible shared across uses. This, along with possible time restrictions and extensive on-street parking, will create more walkable centres. The establishment of a shared parking district could also be considered in the town centre to further reduce the parking requirements and to encourage a park once attitude when undertaking multiple activities in the town centre.	▪ The provision of time restricted car parking should be encouraged within the village and town centres to encourage parking turnover that benefit local businesses.
Measure 12: Safety elements for network	Crime Prevention Through Environmental Design (CPTED) principals will be applied where possible to all trails and paths in the network. A sub network of lit paths will be provided to encourage after-dark pedestrian and cycle access. Other amenities will be considered as part of the network including water supply, seats, bike racks, and shade structures where appropriate.	▪ CPTED principals should be applied to all trails and paths in the network.
Measure 13: Bicycle parking	To facilitate cycle usage throughout the project, bicycle parking will be provided in close proximity to the schools and sports ovals, in the town and village centres and will be encouraged as part of the development of employment and other commercial uses. Other areas of key Open Spaces will also have bicycle parking.	▪ Bicycle parking should comply with Australian Standard, Parking facilities, Part 3: Bicycle parking (AS 2890.3). ▪ Bicycle parking could be provided at school, sports fields, town and village centres. This parking is to be provided in open places that is easily accessible to cyclists. Within the medium and high density residential buildings, bicycle parking should be provided in accordance with the requirements of SEPP 65. ▪ Bicycle parking could be provided on racks as well as secure parking at workplaces, schools, town and village centres.
Public Transport Principles		
Measure 14: Bus network provision	A hierarchy of bus routes should be developed and implemented. Coordination with TfNSW and Premier Illawarra will be required, including approximately 12 months lead time for the implementation of new routes.	▪ A bus network hierarchy should be developed with a strategic/ regional bus route providing fast direct services to regional centres. Local bus services should feed to the key land uses and central bus interchange located at the town centre.

Sustainability measures	Calderwood Urban Development Project Concept Plan TMAP 2010	Commentary
		▪ Plans for these bus routes should be developed as soon as possible given new residents are occupying the area. ▪ Potential for on-demand bus services to run as a local feeder service could be considered.
Measure 15: Services levels that meet and exceed TfNSW Outer Metropolitan Service Planning Guidelines	Frequent services will need to be provided as early as possible to encourage public transport usage and discourage the purchase of additional vehicles.	▪ The design of the services should be in line with the Integrated Public Transport Service Planning Guidelines.
Measure 16: Early bus service provision	Work with State Government and local transport providers (Premier Illawarra) to enable provision of early bus services for the development. Bus services to the CUDP should as a minimum be available from date of first resident moving in, with staging of the development designed to facilitate efficient bus services at all times, subject to negotiations with NSWTI and premier Illawarra.	▪ Currently, Premier Illawarra Route 75 is operating in the CUDP.
Measure 17: Bus stop infrastructure	A hierarchy of bus stops should be developed and implemented.	▪ Where possible, all bus stops must be constructed to the Disability Standards for Accessible Public Transport Guidelines (DSAPT). ▪ At a minimum, bus stop infrastructure should include TfNSW bus stop and timetable. ▪ Where possible, bus stops should be located after intersections to reduce vehicle conflicts for approach traffic turning left at an intersection.

4.7.2 Additional Measures

4.7.2.1 Point to Point Transport

Point to point transport services operate similar to, and compete, with taxi services. These include Uber, Taxify and Go Catch and are booked using mobile phone applications. They generally offer cheaper alternatives to taxis.

4.7.2.2 Car Share

Car share decreases the need for some people to own a car or a second car and can therefore reduce parking demand and traffic generation. It also forces people to consider the cost of driving at the time of driving which is more likely to influence behaviour.

Car share differs from traditional car hire companies in that cars can be hired by half hour increments and cars are located near to where people live or work. Car share is available from either privately operated companies or peer-to-peer services for individual owners to share their vehicles.

Peer to peer car share services generally offer both cheaper and more expensive hire rates than private operators depending on the value of the vehicle. Peer to peer car share services available in Australia include:

- GoGet;
- Car next door; and
- Drive my car.

Car share is generally only feasible in higher density areas due to the take up rates required. This could be trialled in higher density areas of the development at Calderwood.

4.7.3 Conclusions

- Existing sustainable transport measures have been assessed to check their implementation / adoption in real time
- Following additional measures could be considered to promote sustainable travel choice in CUDP:
  - Point to point transport; and
  - Car share.

5 Key Findings

The key findings from this assessment can be summarised as follows.

- A number of external changes have occurred since the TMAP was produced in 2010. The following changes are not attributable to the Calderwood Yield Review, but were nevertheless included in this assessment:
  - The design of the Albion Park Rail bypass is consistent with the approved concept design, involving changes to the Central Interchange at Albion Park.
  - The design of Tripoli Way (Albion Park bypass) is consistent with Council's current preferred configuration.
  - The land use assumptions for the wider West Lake Illawarra region are based on the latest available land use information for future horizon year 2036, and consistent with the Albion Park Rail bypass EIS.
- Based on TRACKS strategic model outputs, the CUDP Yield Review results in a maximum of:
  - 227 additional peak hour trips (one-way) on Calderwood Road.
  - 125 additional peak hour trips (one-way) on Escarpment Drive.
  - 100 additional peak hour trips (one-way) on Marshall Mount Road.
  - 75 additional peak hour trips (one-way) on Tongarra Road.
  - 65 additional peak hour trips (one-way) on Yallah Road.
  - 46 additional peak hour trips (one-way) on the M1 Princes Motorway.
  - 34 additional peak hour trips (one-way) on Princes Highway.
- Overall the road infrastructure proposed as part of the Approved Concept Plan is fit for purpose and the additional dwelling yield does not result in a significant increase in traffic movements such that a material change to the proposed roads or the location of roads is necessary. Based on the revised traffic modelling, the only additional road upgrades considered necessary to mitigate the impacts of the proposed CUDP yield increase are as follows:
  - Widen Calderwood Road from two lanes to four lanes between Tripoli Way and the eastern boundary of the CUDP. Although the mid-block capacity of Calderwood Road is unlikely to be exceeded until full completion of the CUDP, it is recommended that the Calderwood Road upgrade is completed on the opening of the town centre (retail) and completion of the Tripoli Way by-pass, which is anticipated to occur in 2026-2028.
  - Upgrade Illawarra Highway / Broughton Avenue from roundabout to signalised intersection.
  - Upgrade Calderwood Road / Tripoli Way from roundabout to signalised intersection.
- Considering the minor increase in the AM and PM peak hour trips due to the proposed yield increase, further upgrades are not required above and beyond the VPA agreement in respect of the following key roads:
  - Town Centre Bypass (TCB)
  - Marshall Mount Road
  - Yallah Road
  - NR1 – NR 3
- Based on a sensitivity analysis, it was found that local employment within the CUDP has a net positive impact on vehicle kilometres travelled in the road network.
- Based on an assessment of the forecast Average Daily Traffic (ADT) volumes in 2036, it is proposed to change the configuration of the Escarpment Drive / Marshall Mount Road intersection to give priority to Escarpment Drive traffic.
- A pedestrian and cycling network is maintained to encourage active travelling to, through and within the CUDP.

- A short and longer term bus network servicing the CUDP is being implemented with the commencement of Route 75 servicing Calderwood.
- An assessment of Sustainability Measures pertaining to transport, as identified in the TMAP, revealed that the CUDP is being delivered in accordance with the original approval. Where applicable, these measures have been reinforced or strengthened as part of the CUDP Yield Review.
- Detailed design plans for proposed road works to be undertaken as part of each development stage are to be submitted with the relevant development application, consistent with Condition C5 of the Concept Plan approval, including:
  - Plans for the external road network upgrades to be undertaken as works in kind including details of proposed timing / staging for the completion of the works.
  - Plans for proposed internal road and parking arrangements, including number of parking spaces required to meet the demand generated by the proposed development.
- **Table 5-1** outlines how the Calderwood Concept Plan modification aligns with relevant planning provisions, goals and strategic planning guidance.

Table 5-1 Relevance of pedestrian, cyclist and public transport related documents and guidance

SEAR's reference	Applicable document(s)/ guidance	Applicable sections/ policy	Calderwood Concept Plan application
NSW State Priorities	Premier's Priorities	Building infrastructure, improving road travel reliability, 90% of peak travel on key road routes is on time To ensure consistency of journey times on key roads continues to improve, the NSW government is working to make better use of existing road infrastructure, build extra road capacity and encourage commuters to use public transport and to undertake off-peak travel more often.	Provide and encourage the use of public transport to maintain road network reliability.
NSW Long Term Transport Master Plan Draft Future Transport Strategy 2056	Future Transport 2056, Future Transport Strategy 2056.	Future Transport 2056 sets out the vision for transport in NSW considering its links to people, places, the economy, environment and its overall performance. The vision is reproduced as follows:  *Source: Future Transport Strategy 2056, Transport for NSW, March 2018*	The proposed transport network for Calderwood is compatible and can help facilitate the vision set out in Future Transport 2056.
Roads and Maritime Guide to Traffic Generating Developments	Household Travel Survey (HTS) data.	HTS provides a snapshot of travel patterns for all modes and trip purposes by local government areas.	HTS was used to estimate all trips (not just private vehicles) likely to be generated on a typical day at Calderwood.

SEAR's reference	Applicable document(s)/ guidance	Applicable sections/ policy	Calderwood Concept Plan application
Draft Regional NSW Services and Infrastructure Plan	Future Transport 2056, Regional NSW Services and Infrastructure Plan	The document outlines Sate-wide initiatives in: Policy/ Planning, Service and Infrastructure. Specific initiatives that could have direct impacts on Calderwood include: Planning: Travel demand management policies and tools to support car sharing as well as to assist workers and employers to better manage travel. Service: Rapid Bus Package for Illawarra / Shoalhaven.	The Regional NSW Services and Infrastructure Plan builds on from Future Transport Strategy 2056. It provides a range of initiatives that apply across regional NSW with the intent to improve the attractiveness and use of active and public transport leveraging off technology improvements and using existing infrastructure more effectively.
Public Transport Service Planning Guidelines: Rural and Regional NSW (2015)	Integrated Public Transport Service Planning Guidelines, Outer Metropolitan Area (2016)	The provides the principles for the provision of public transport services.	The potential bus network has been designed with guidance from this document.
Austroads Guidelines	Guide to Road Design Part 6A Paths for Walking and Cycling	This guidance document outlines general principles and indicative metrics for the design of pedestrian and cycle paths.	Proposed paths generally align with this guidance document. Detailed design must also consider this.
NSW Bicycle Guidelines. NSW Planning guidelines for walking and cycling.	Guide to Road Design Part 6A Paths for Walking and Cycling. Australian Standards 1742, 1743, 7429 and 2890.	As of 1 January 2011, Roads and Maritime Services adopted Austroads guides (Guide to Traffic Management) and Australian Standards (AS 1742, 1743, 7429 and 2890) as its primary technical references for the design of bicycle infrastructure. A Roads and Maritime supplement has been developed for each part of the Guide to Traffic Management and relevant Australian Standards, and these must be referred to prior to using any reference material. Austroads guidelines (Guide to Road Design Part 6A Paths for Walking and Cycling) supersedes NSW Planning guidelines for walking and cycling.	Detailed design of bicycle infrastructure must consider this. At a concept level, the plans show compliance for the aspects considered.

SEAR's reference	Applicable document(s)/ guidance	Applicable sections/ policy	Calderwood Concept Plan application
Crime Prevention Through Environmental Design (CPTED) Principles	NSW Police	The aims of CPTED are to: ▪ Maximise the risk to offenders; ▪ Maximise the effort to commit a crime; ▪ Minimise the actual and perceived benefits of crime; and ▪ Minimise excuse making opportunities. CPTED is based around four key strategies: ▪ Territorial re-enforcement; ▪ Surveillance; ▪ Access Control; and ▪ Space/ Activity Management.	The Calderwood Concept Plan indicates this has considered CPTED strategies. Proposed land uses face towards active transport corridors. Surveillance is maximised through long view lines. Proposed access provides a good balance of permeability while funnelling people through common locations. Space/ Activity Management requires formal supervision, this can incidentally occur with organised sports and activities in open space and the street network.

6 References

Reference has been made to following documents while preparing this traffic and transport report.

- CUDP Transport Management and Accessibility Plan (2010).
- Consolidated Development Control Strategy (JBA, 2018).
- CUDP Development Control Plan (2013).
- APRB Traffic and Transport Assessment Report (Addendum, 2017).
- Albion Park Rail Bypass Environmental Impact Statement (EIS, 2015).
- Illawarra-Shoalhaven Regional Plan (2015).
- NSW Long Term Transport Master Plan (2012).
- Future Transport Strategy 2056 (2018).
- Regional NSW Services and Infrastructure Plan (2018).
- Roads and Maritime Guide to Traffic Generating Developments (2002).
- Public Transport Service Planning Guidelines: Rural and Regional NSW (2015).
- Austroads Guide to Road Design Part 6A Paths for Walking and Cycling (2017).
- NSW Bicycling Guidelines (2011).
- NSW Planning Guidelines for Walking and Cycling (2004).
- Crime Prevention Through Environmental Design (CPTED) Principles (2011).

APPENDIX

A

EXISTING ROAD HEIRARCHY IN CUDP AREA OF INFLUENCE

Source: TMAP (2010)

Southern (F6) Freeway

The Southern (F6) Freeway is located to the north east of the development site, running north-south and has a speed limit of 110 km/hr. The Freeway assumes the role of providing for through traffic between Sydney, Wollongong and points further south, bypassing the Princes Highway and Dapto Town Centre. In the study area, the Freeway is comprised of dual two-lane carriageways, separated by a wide, grassed median. Grade-separated crossings of the Freeway are provided at Martin Street (footbridge only), Emerson Road and Fowlers Road. Access to/from the Freeway is provided via north-facing ramps at Fowlers Road and south-facing ramps at Princes Highway, Tallawarra (the southern terminus of the freeway). There are no south-facing ramps on the Freeway south of Northcliffe Drive at Berkeley, and no north-facing ramps at the Princes Highway junction at Tallawarra.

Photograph 1 Southern Freeway looking north from Fowlers Road

Princes Highway (north of Tallawarra)

This section of **Princes Highway**, formerly part of the main inter-regional route between Sydney, Wollongong and points further south, now functions as a sub-arterial route serving Dapto Town Centre. Through the study area, the Highway generally comprises of a two-lane undivided carriageway. The speed limit through the study area is 80 km/hr, slowing to 60km/h as it enters the built up area of Dapto.

Photograph 2 Princes Highway looking north from the Southern Freeway

Princes Highway (south of Tallawarra)

This section of Princes Highway forms part of the major inter-regional route between Sydney, Wollongong and the South Coast, linking directly to the southern end of the Southern Freeway at Tallawarra. It generally consists of two travel lanes in each direction, on dual carriageways north of Illawarra Highway and on a single, undivided carriageway south of Illawarra Highway. The speed limit is 100km/h between the Southern Freeway and Macquarie Rivulet, 70km/h between Macquarie Rivulet and Creamery Road, 60km/h between Creamery Road and Tongarra Road, and 70km/h from Tongarra Road to the edge of the study area.

Photograph 3 Princes Highway looking north from Tongarra Road

Illawarra Highway

Illawarra Highway is located to the south and east of the development site and is a major highway linking the Illawarra with inland New South Wales. It commences at a roundabout at the intersection with the Princes Highway, running south across floodplain to Albion Park before turning west and running through the Macquarie Rivulet valley en route to Macquarie Pass. It is generally a two-lane undivided carriageway, except through Albion Park where it becomes a four-lane undivided carriageway. West of Hamilton Road, the carriageway widens from 12 metres to 18 metres before narrowing again east of Polock Crescent. A speed limit of 60km/h applies through Albion Park, increasing to 90km/h between Albion Park and Princes Highway and 100km/h west of Broughton Avenue. A school zone applies between Polock Crescent and Calderwood Road at Albion Park.

Photograph 4Illawarra Highway looking east from Calderwood Road

Tongarra Road

Tongarra Road is an arterial road linking Illawarra Highway at Albion Park with Princes Highway at Oak Flats. It is a two-lane undivided carriageway for most of its length, widening to four lanes on approach to the junctions with Princes Highway and Illawarra Highway. The eastern-most 600 metres has a concrete median. The speed limit alternates between 60km/h and 80km/h – the 80km/h zone being located between the eastern edge of Albion Park and Croome Road.

Photograph 5Tongarra Road looking west across Frazers Creek

Huntley Road

Huntley Road is a collector road, running east-west between the Princes Highway and Avondale Road. It is generally a two-lane undivided carriageway. Through the existing urban area it has a 10 metre wide pavement with kerb and gutter on the northern side. The line markings are also off-centre, to allow on-street parking along the northern side of the pavement. To the west of the existing urban area, Huntley Road is a two-lane rural carriageway 5 metres wide, with unsealed shoulders. The speed limit is 80 km/hr. It reduces to 50 km/hr in the built up area between Penrose Street and Princes Highway

Photograph 6 Huntley Road looking east towards the existing urban area

Marshall Mount Road

Marshall Mount Road is a two-lane undivided, 6 metre wide carriageway with an 80km/h speed limit. It links Huntley Road at the rail overpass with Calderwood Road, skirting the north-western edge of the development site. A single-lane bridge over a branch of Duck Creek is located 1.3km north of Yallah Road. The pavement is generally in good condition except for the final 500m on approach to Calderwood Road.

Photograph 7Marshall Mount Road looking north near Calderwood Road

Yallah Road

Yallah Road is a two-lane undivided carriageway linking Princes Highway with Marshall Mount Road. It has a speed limit of 80km/h, except in the vicinity of Princes Highway where a 60km/h speed limit applies. Pavement width is generally 6 metres, widening to 7 metres on approach to Yallah.

Photograph 8 Yallah Road looking west to Marshall Mount Road

Calderwood Road

Calderwood Road is a two-lane undivided carriageway linking Albion Park with a number of rural properties in the Calderwood area. Pavement width is generally 6 metres in the rural section, widening to 12 metres within Albion Park urban area. A speed limit of 50km/h applies within the Albion Park urban area and a speed limit of 80km/h in the rural area. A school zone also applies for 600 metres west from the intersection with North Macquarie Road.

Photograph 9 Calderwood Road

North Macquarie Road

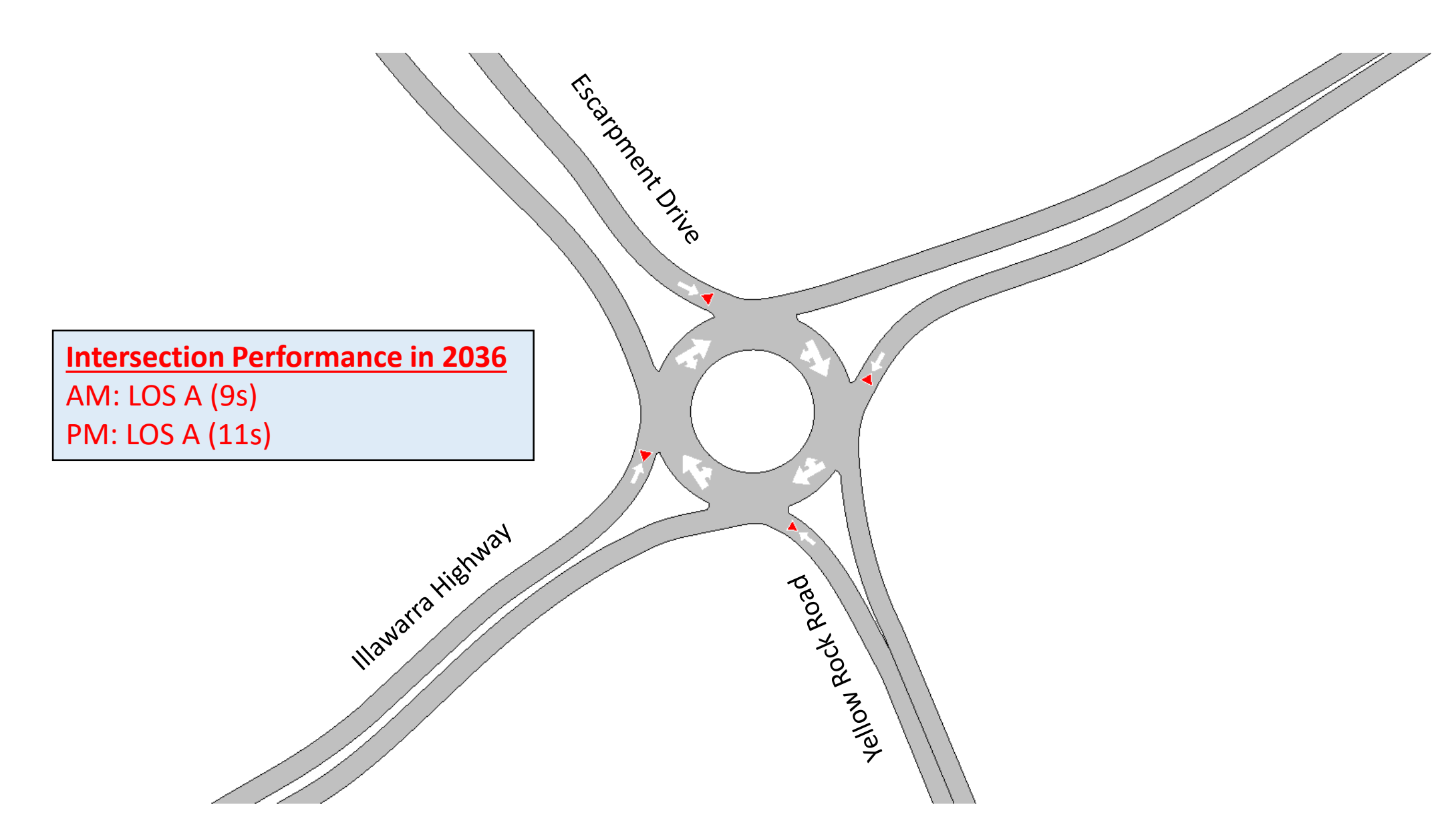
North Macquarie Road is a two-lane undivided carriageway, generally 4-5 metres in width, linking Illawarra Highway with Calderwood Road along the northern side of Macquarie Rivulet. It has a signposted speed limit of 80km/h for the majority of the route, with a 60km/h limit applying in the vicinity of the small concrete ford over Macquarie Rivulet. The immediate southern approach to Macquarie Rivulet is only one-lane wide.

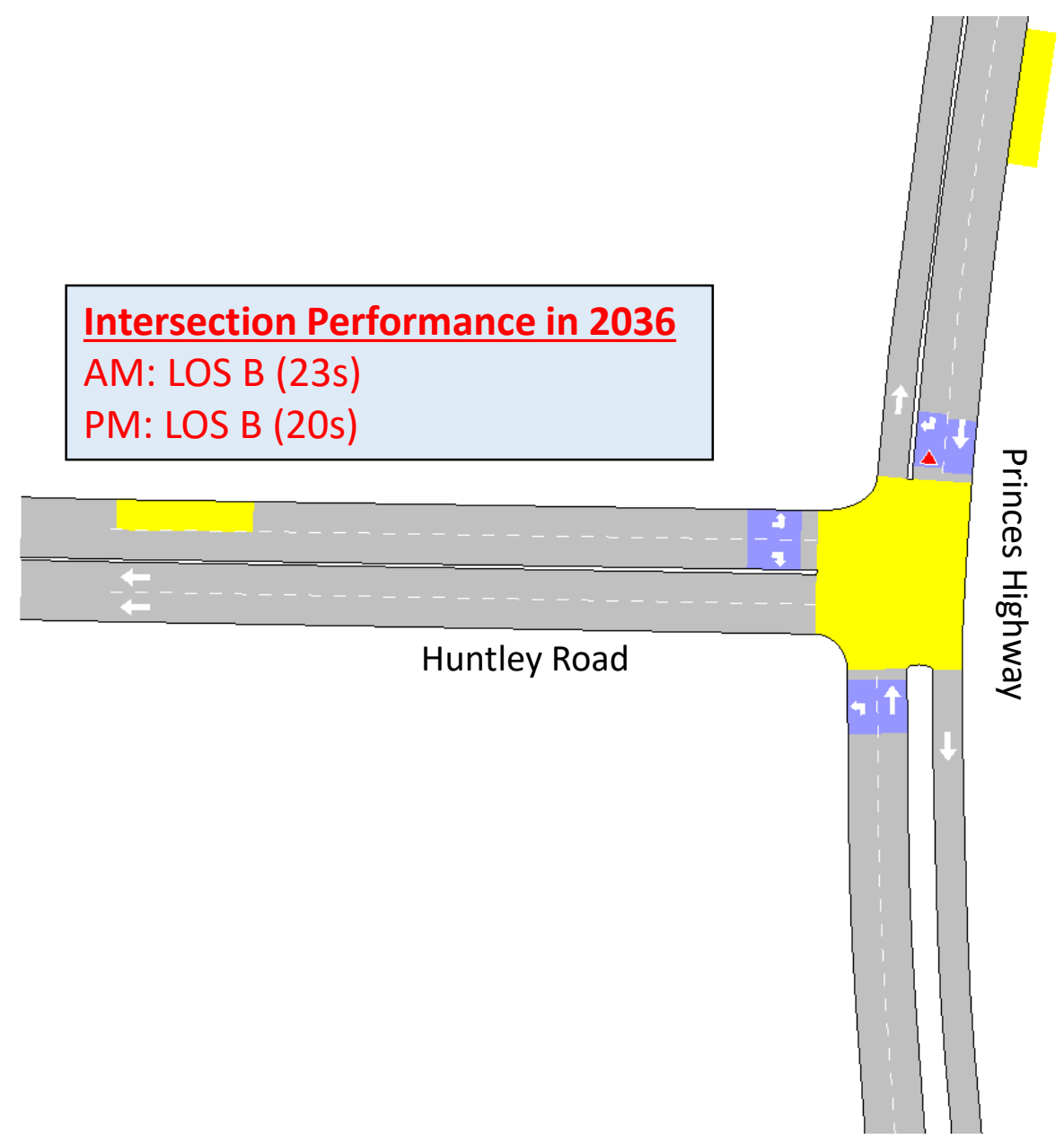
Photograph 10 North Macquarie Road at Macquarie Rivulet

APPENDIX

B

INTERSECTION LAYOUT & PERFORMANCE WITH PROPOSED CUDP YIELD INCREASE

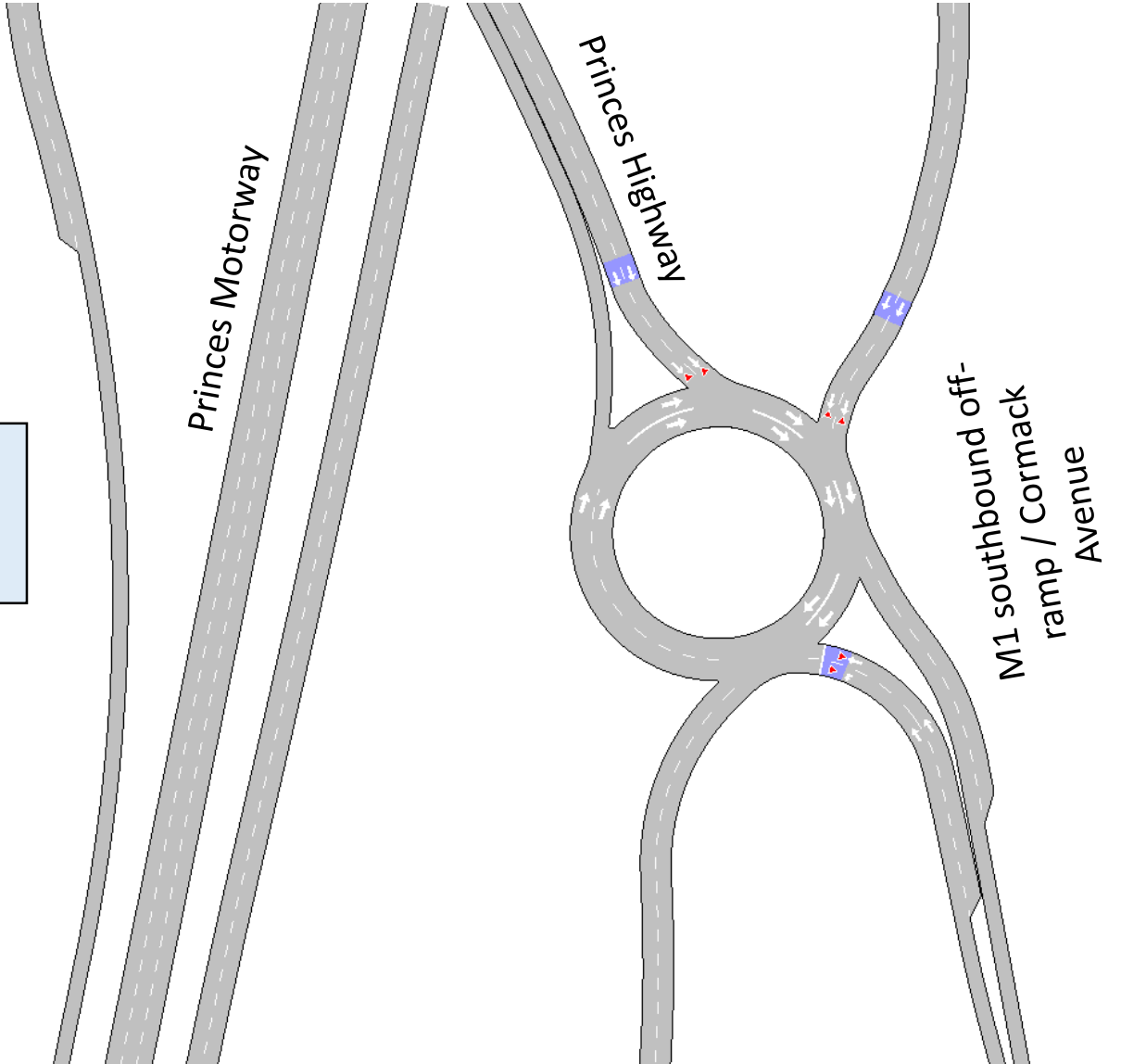

Escarpment Drive
Illawarra Highway
Yellow Rock Road
Intersection Performance in 2036
AM: LOS A (9s)
PM: LOS A (11s)

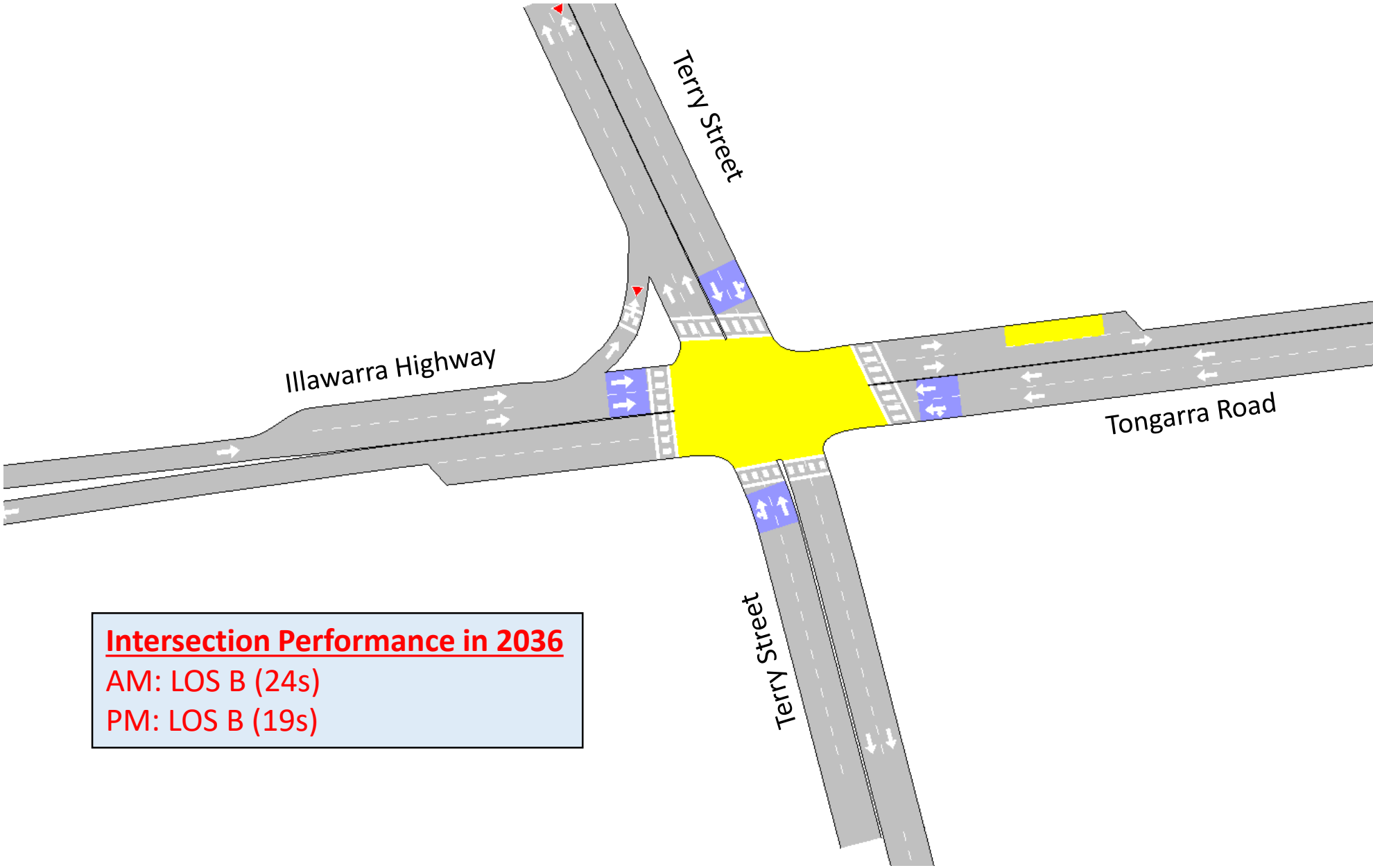

Intersection Performance in 2036
AM: LOS B (23s)
PM: LOS B (20s)
Huntley Road
Princes Highway

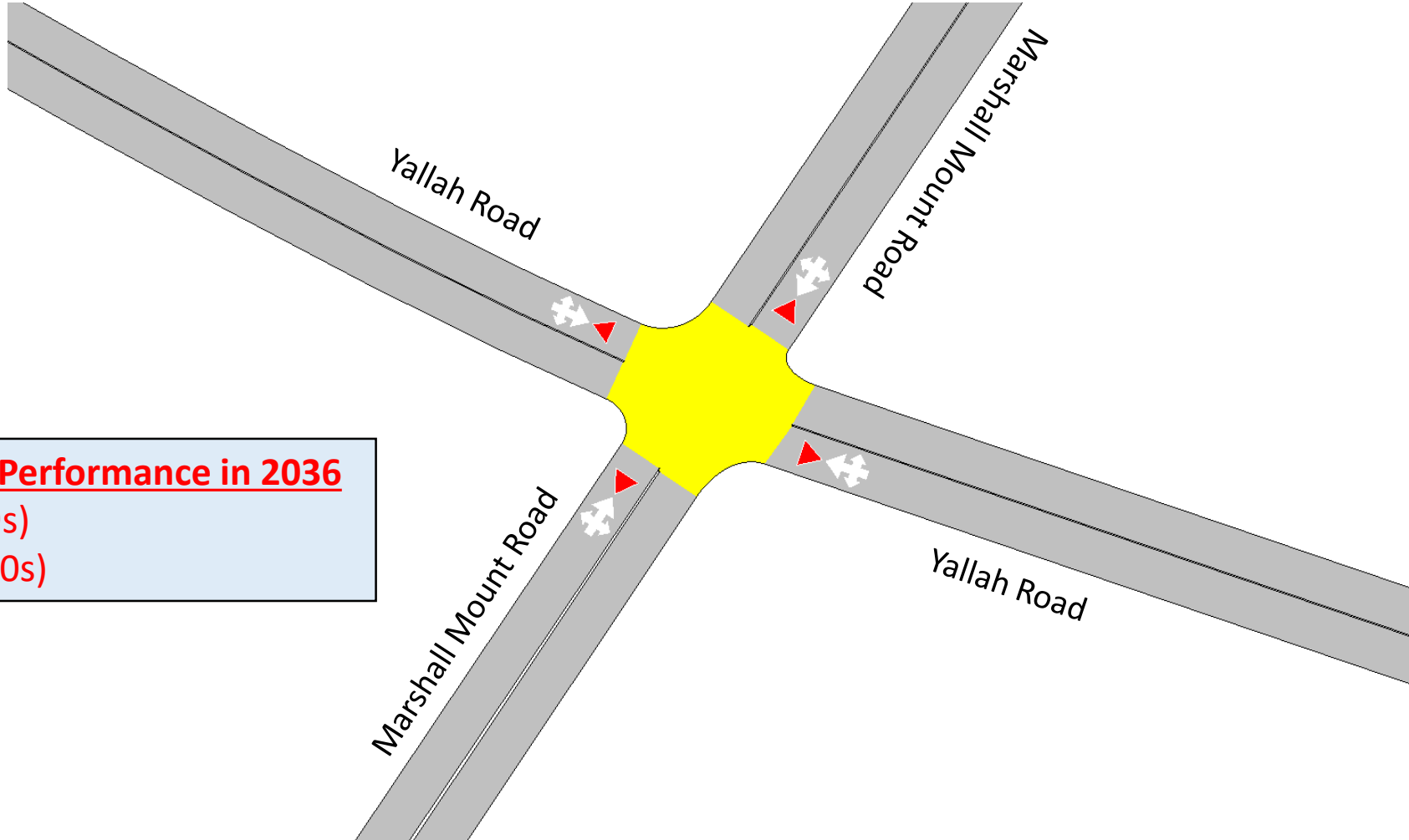
Intersection Performance in 2036

AM: LOS B (22s)

PM: LOS B (22s)




Terry Street
Illawarra Highway
Tongarra Road
Terry Street
Intersection Performance in 2036
AM: LOS B (24s)
PM: LOS B (19s)



Intersection Performance in 2036

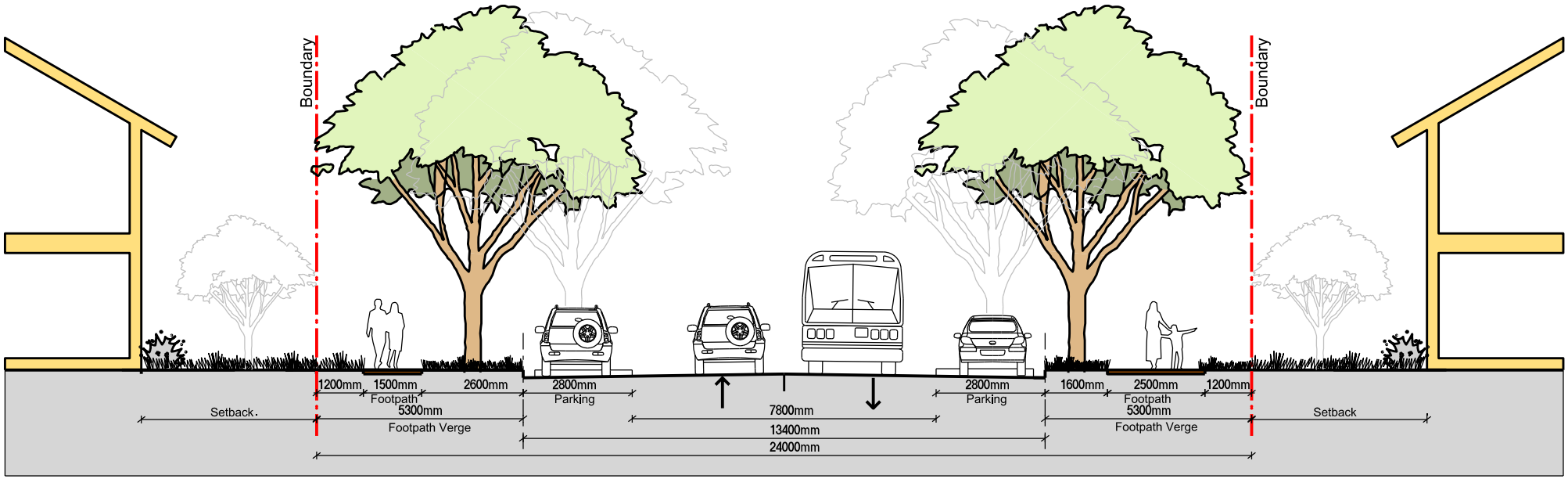
AM: LOS A (9s)

PM: LOS A (10s)

APPENDIX

C

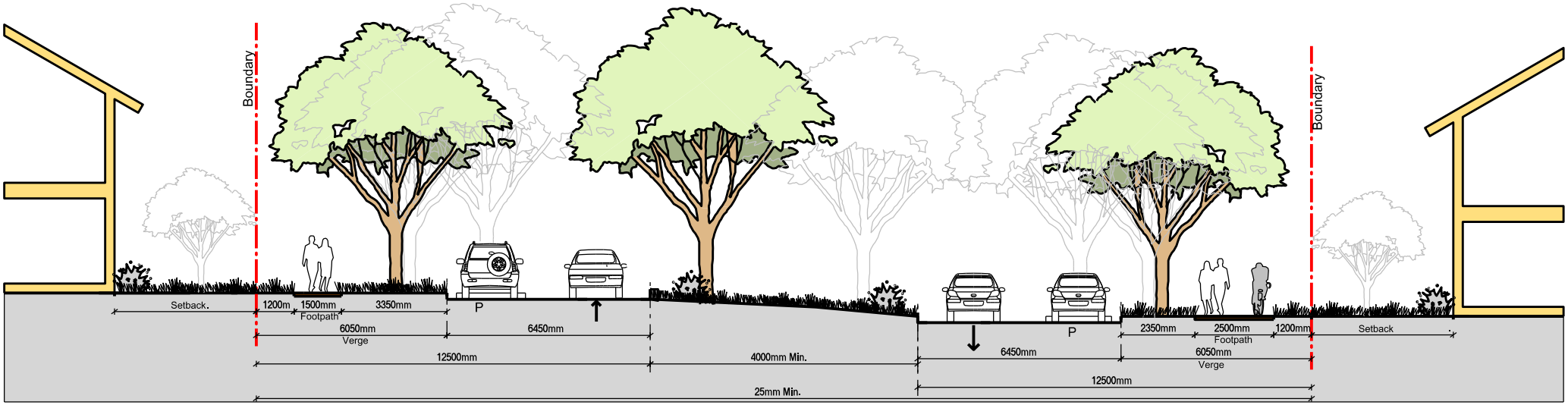
CUDP ROAD CROSS-SECTIONS



Sub Arterial Road

With Bus Service

Section A1



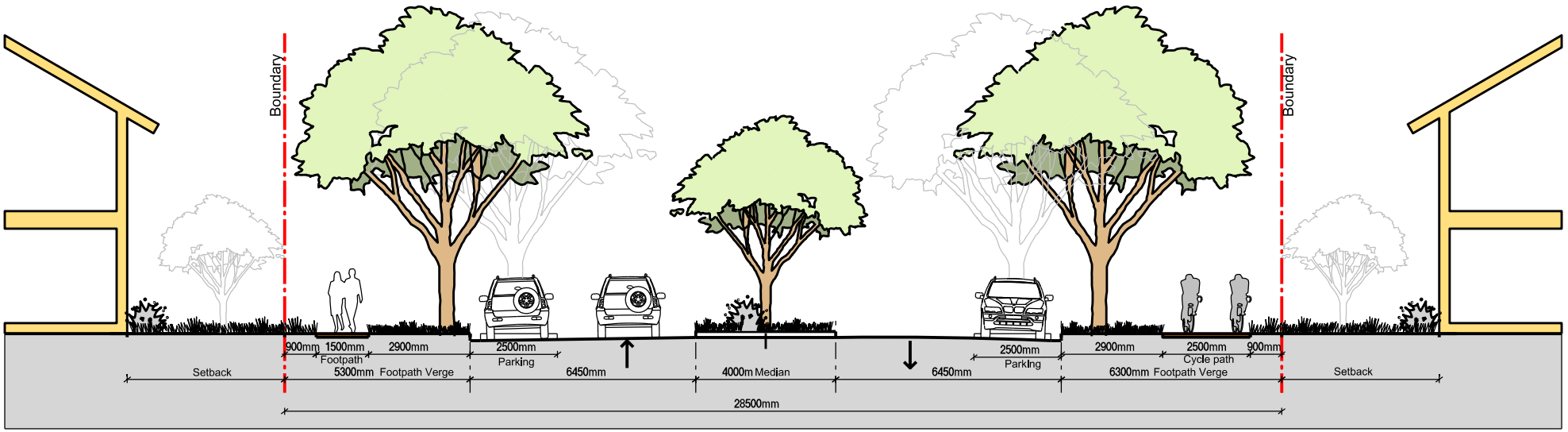
Sub Arterial Road with Median

one way traffic lanes with parking

Section A2

ESCARPMENT DRIVE

Stage 1 and 10/11

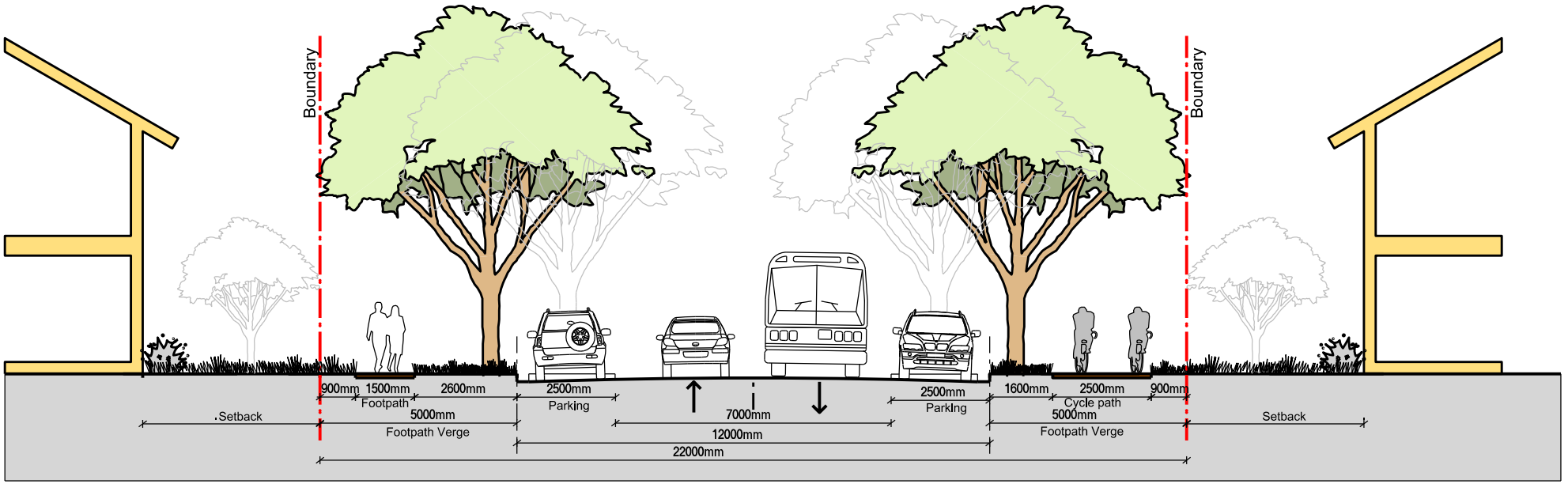


Sub Arterial Road

One lane in each direction with Parking Bays

Section A3

ESCARPMENT DRIVE

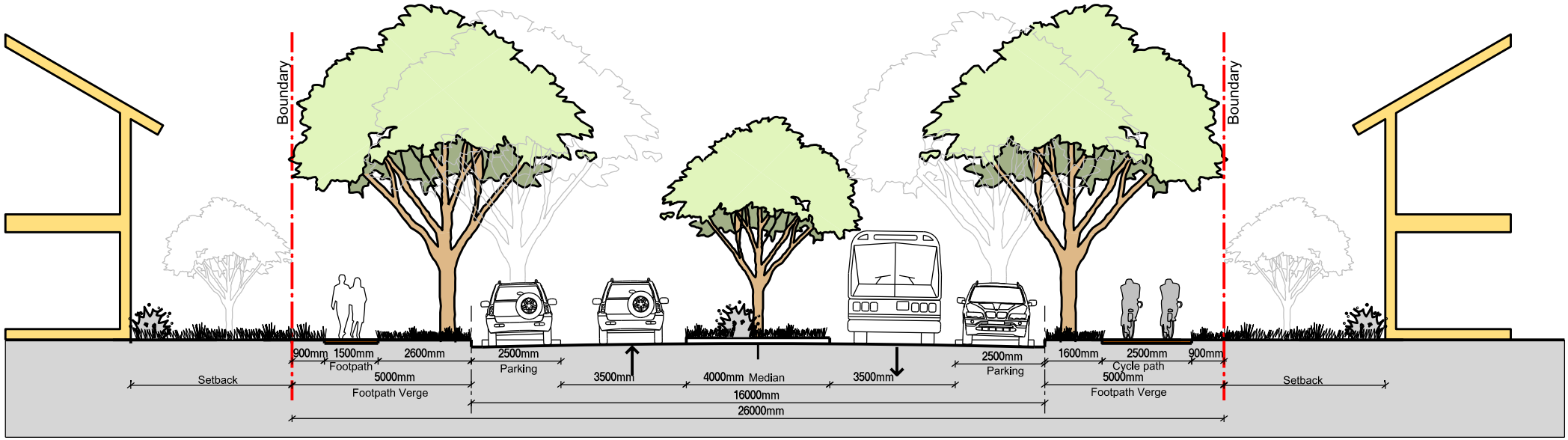


Major Collector Road

Parking on Both Sides and Bus Service

Section B1

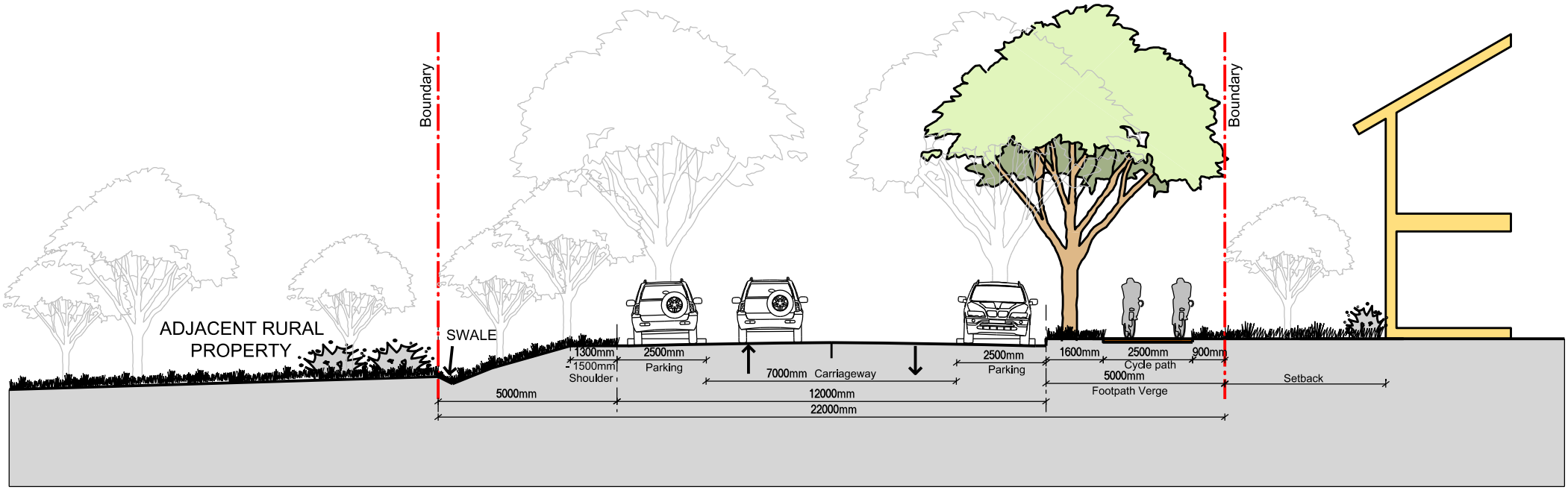
CALDERWOOD ROAD



Major Collector With Median

Parking on Both Sides and Bus Route

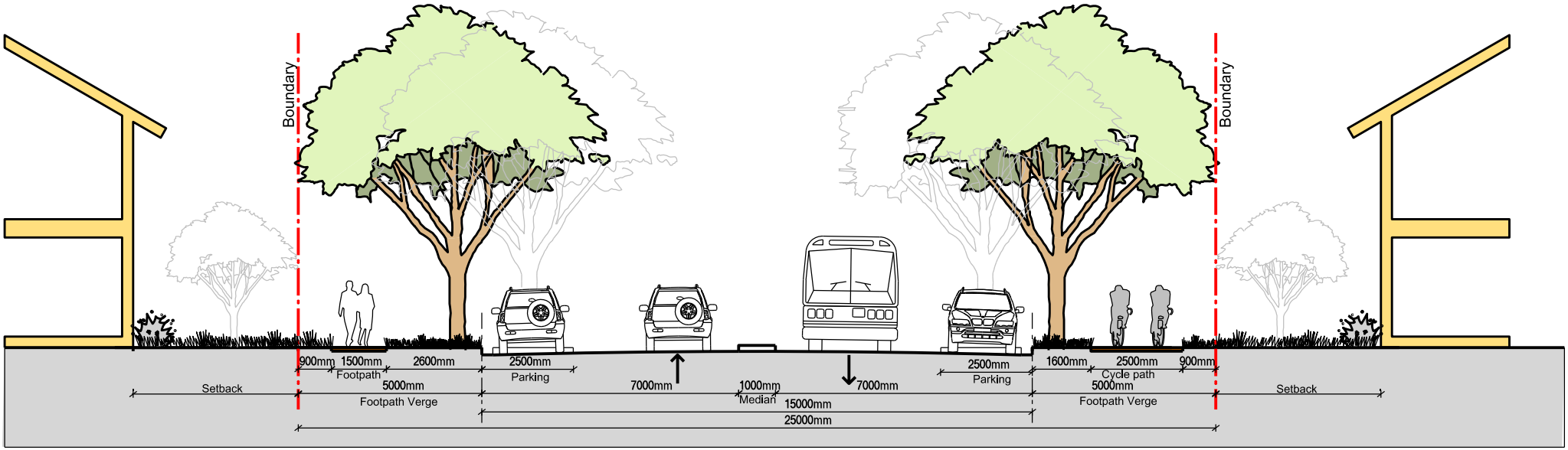
Section B2



Major Collector Adjacent Rural Lands

Section B3

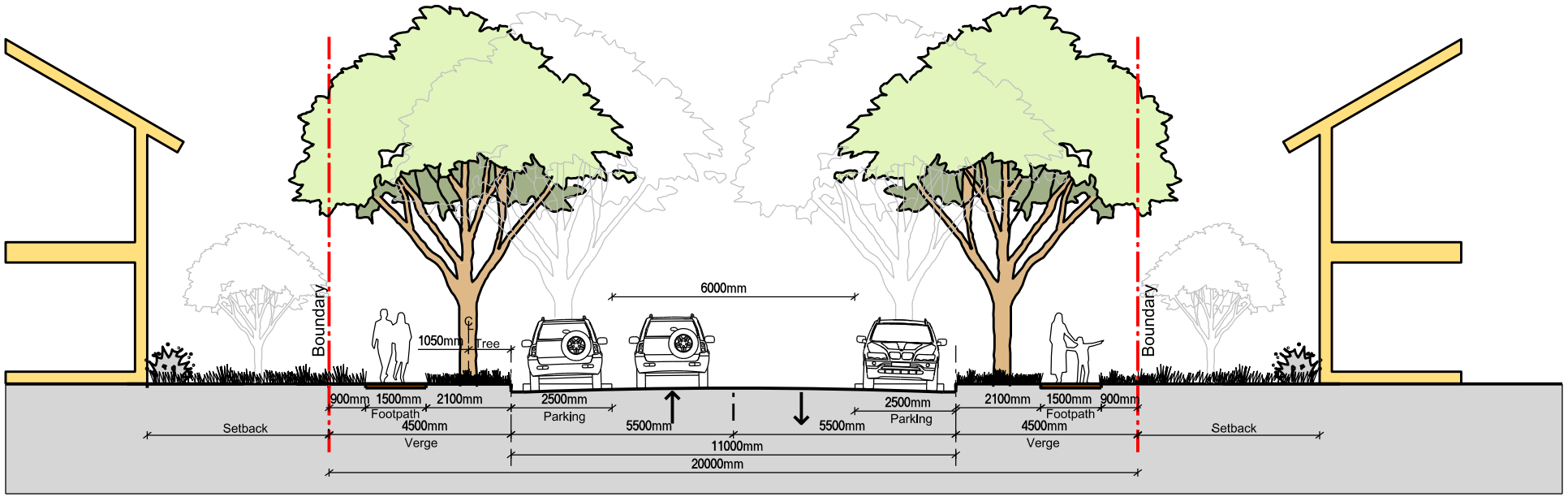
CALDERWOOD ROAD/ NORTH MACOUARIE



Major Collector With Median

Parking on Both Sides and Bus Route

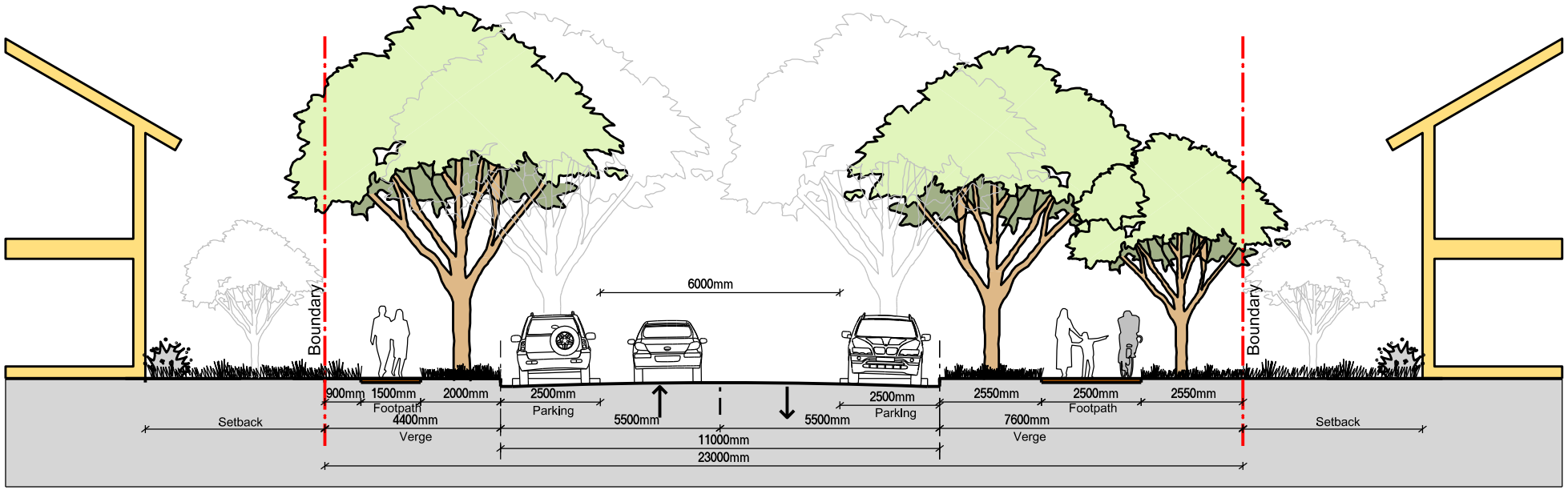
Section B4



Minor Collector

Parking on Both Sides

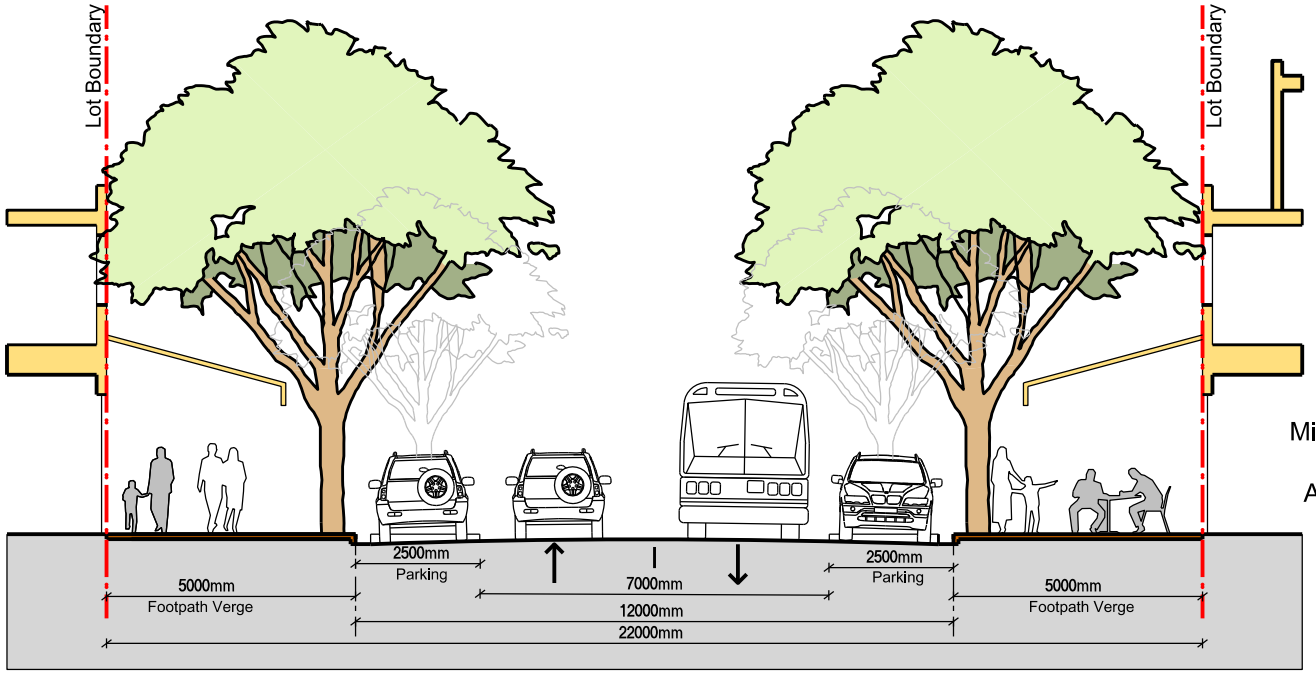
Section C1



Minor Collector - Pedestrian Priority Street

Parking on Both Sides - Tree pits optional

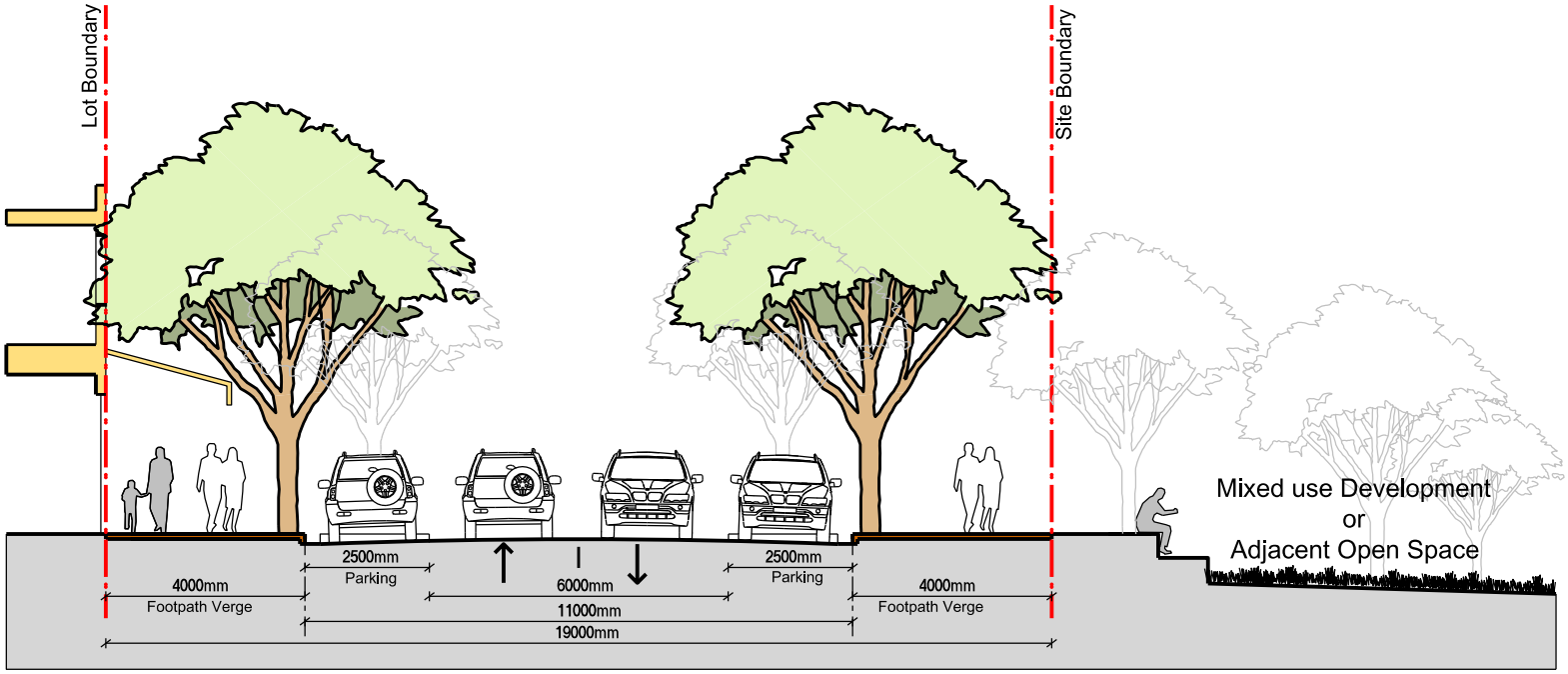
Section C2



Village Centre Collector Road

Parking Both Sides ,Fully Paved Verge and Bus Route. Tree pits optional

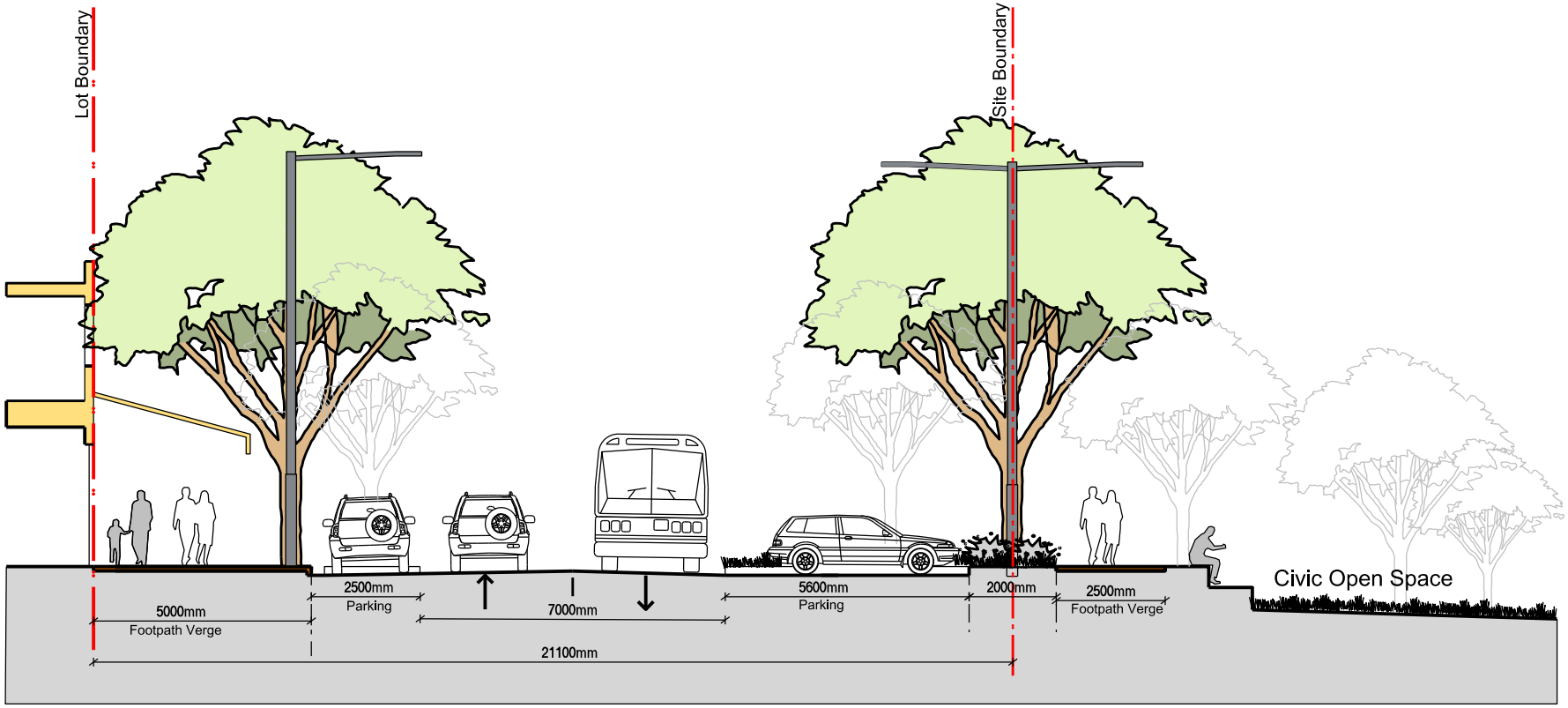
Section D1



Village Centre Access Street

Parking on Both Sides and Fully Paved Verge.Tree Pits optional.

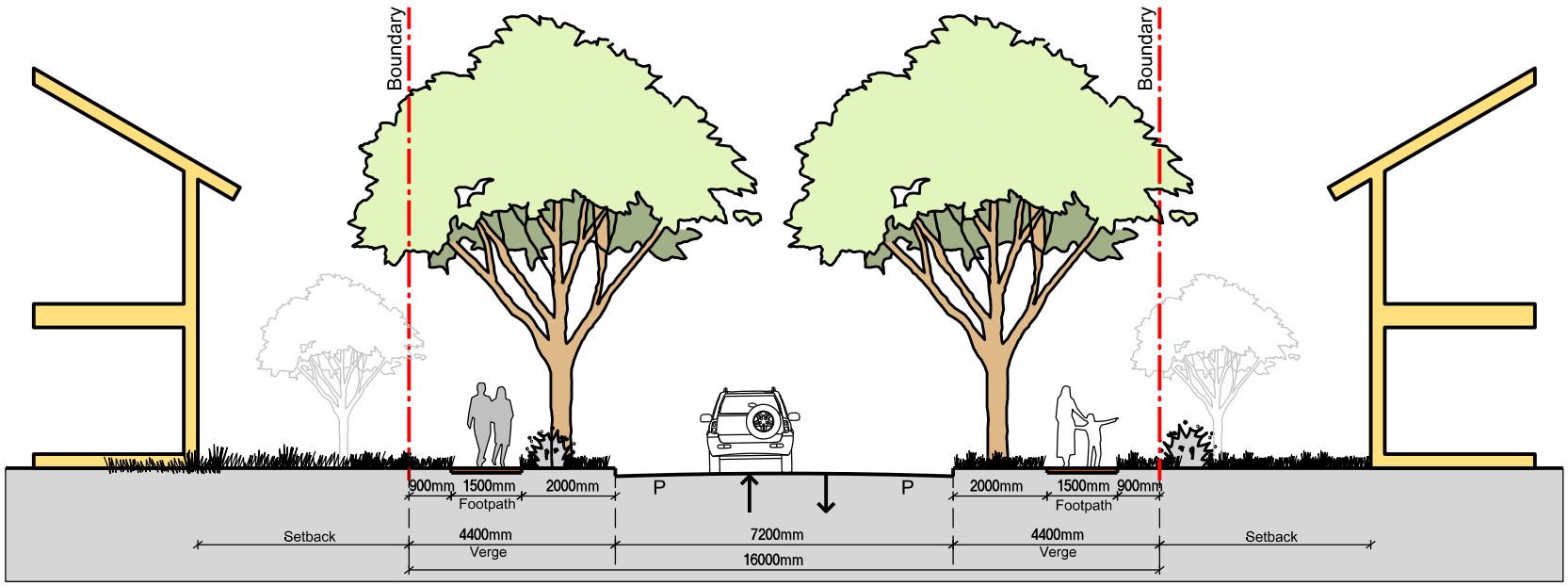
Section D2



Town Centre Main Street

Parking Both Sides and Perpendicular Parking to Open Space Edge,Fully Paved Verge and Bus Route. Tree pits optional

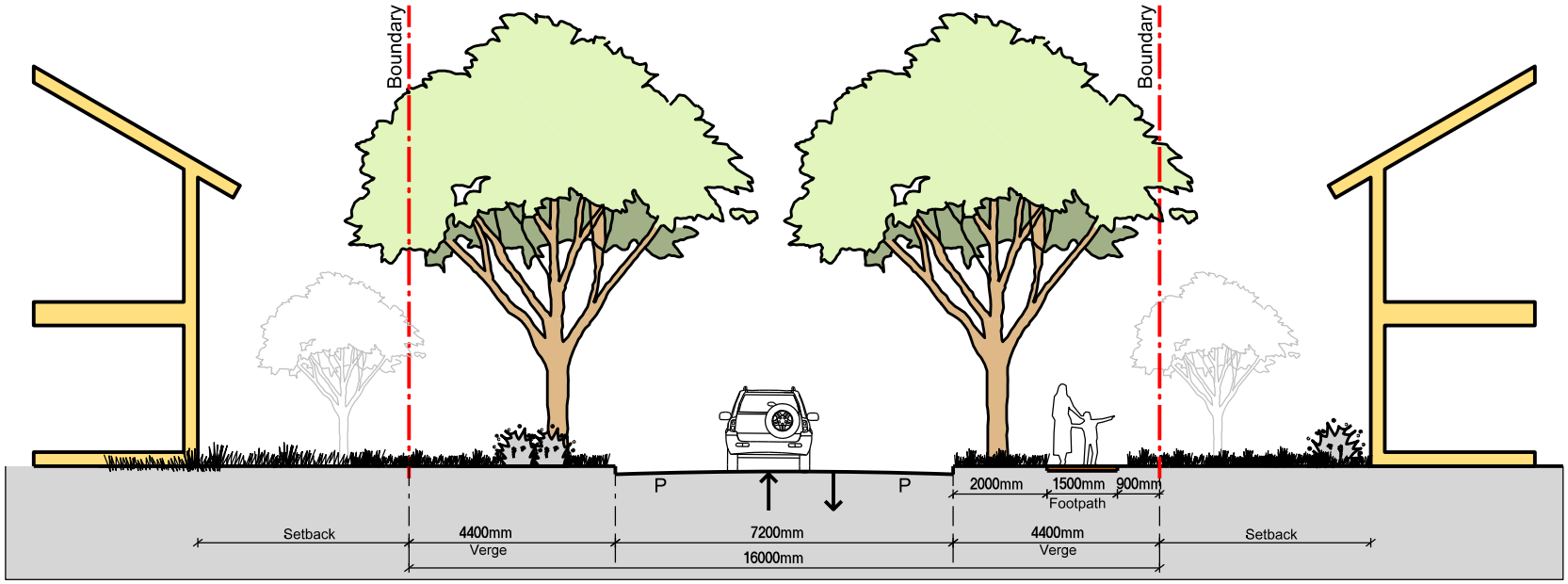
Section D3



Access Street - Town

On Street Parking , Footpath on both sides

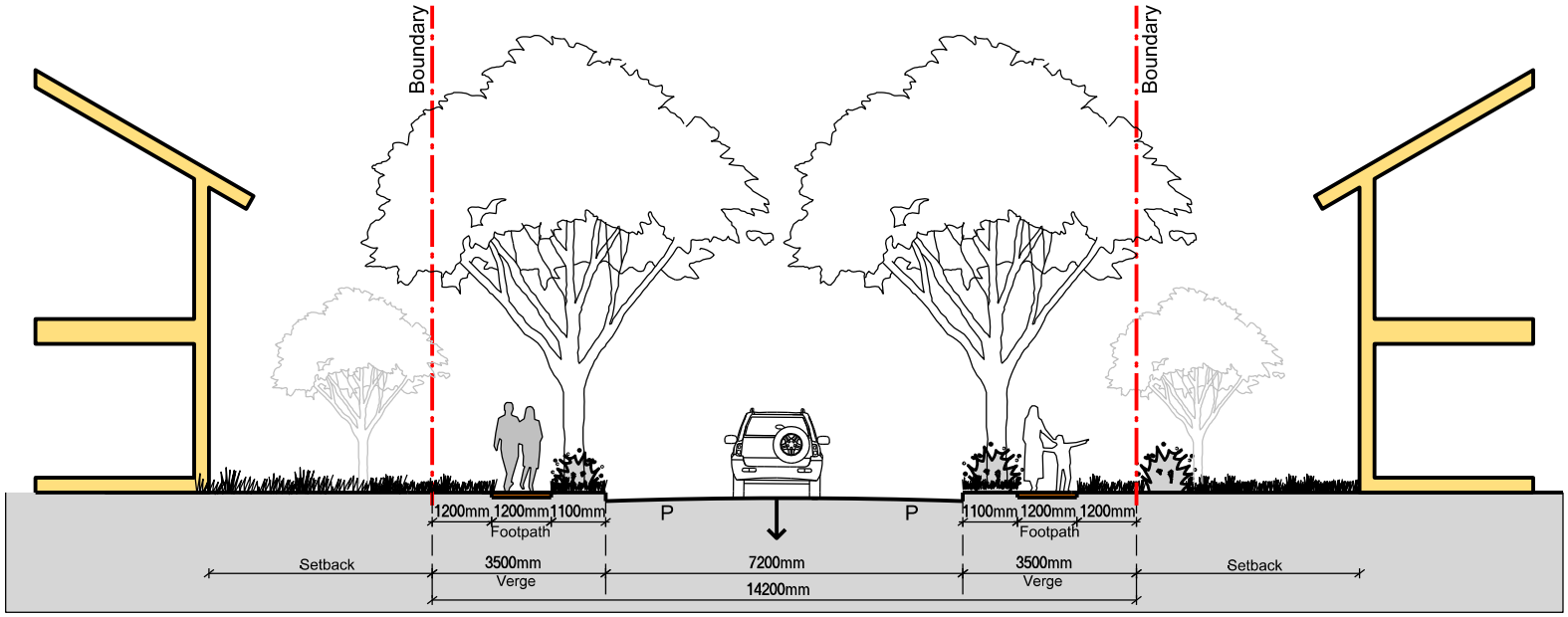
Section E1



Access Street (Standard Residential Street At Calderwood)

On Street Parking , Footpath on one side

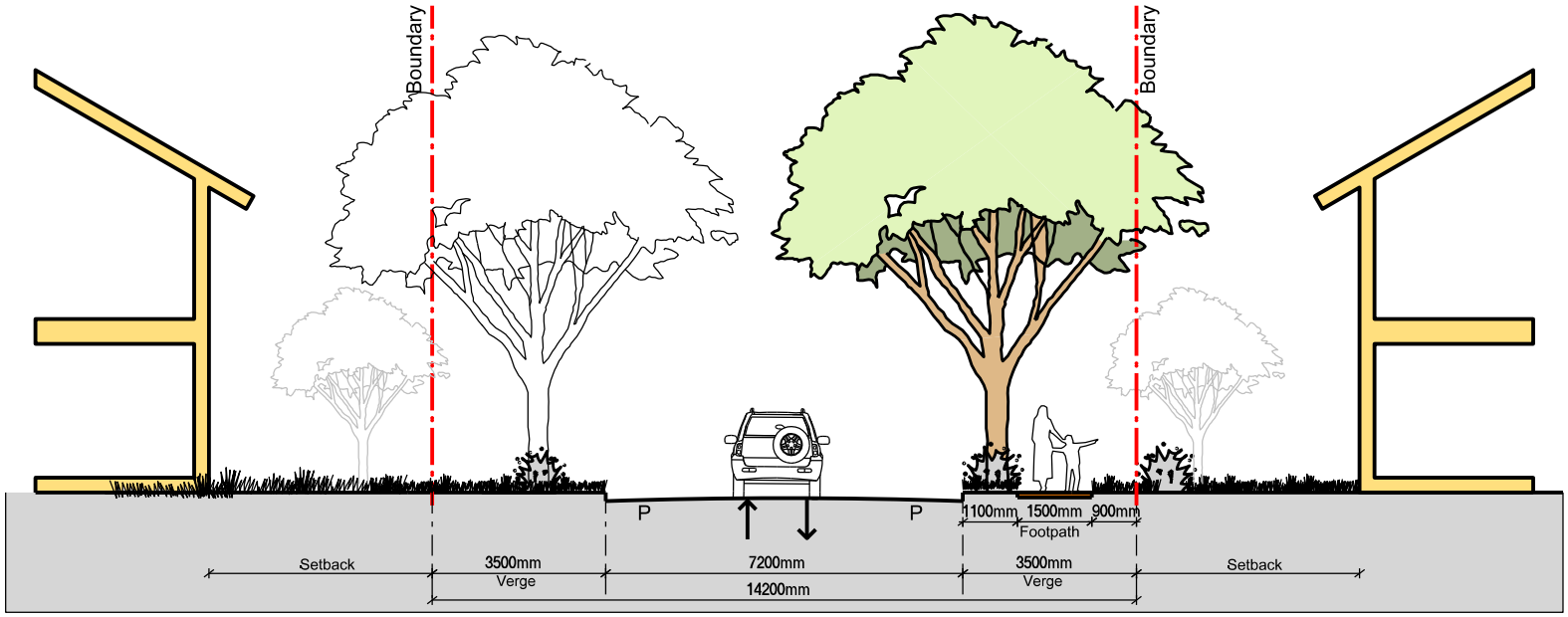
Section E2



Access Street - Urban One-Way

On Street Parking , Footpath on both sides

Section E3

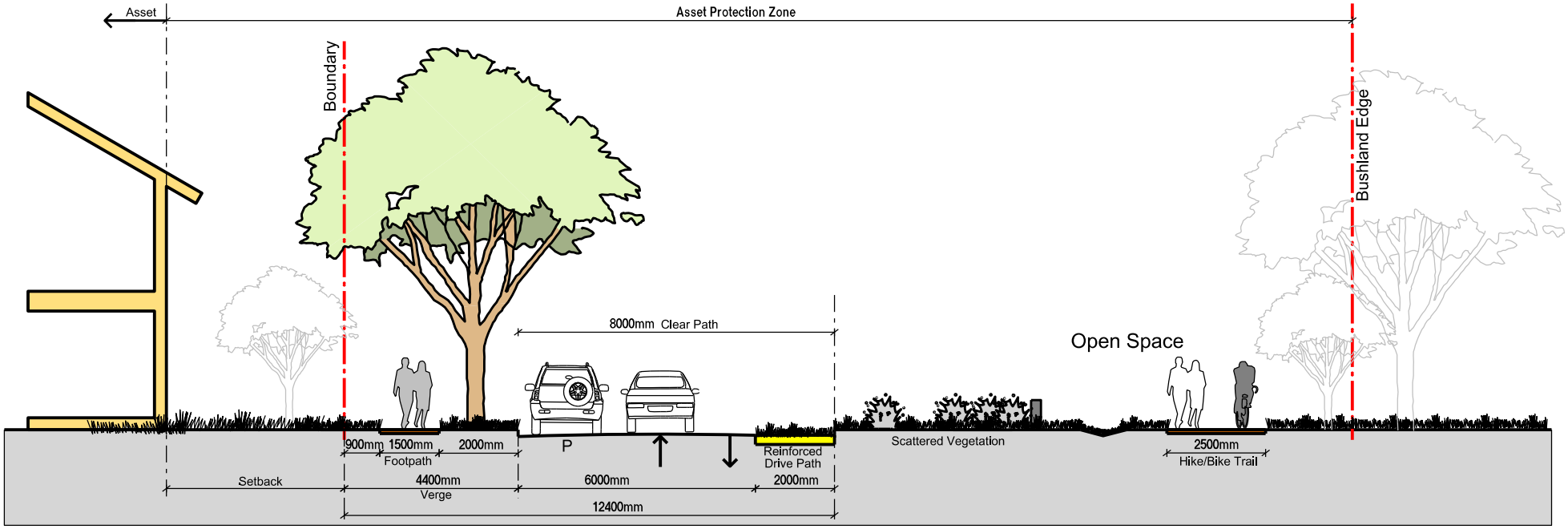


Access Street - Urban

(Standard Urban Town Centre And Village Centre Calderwood Street Section)

On Street Parking , Footpath on one side

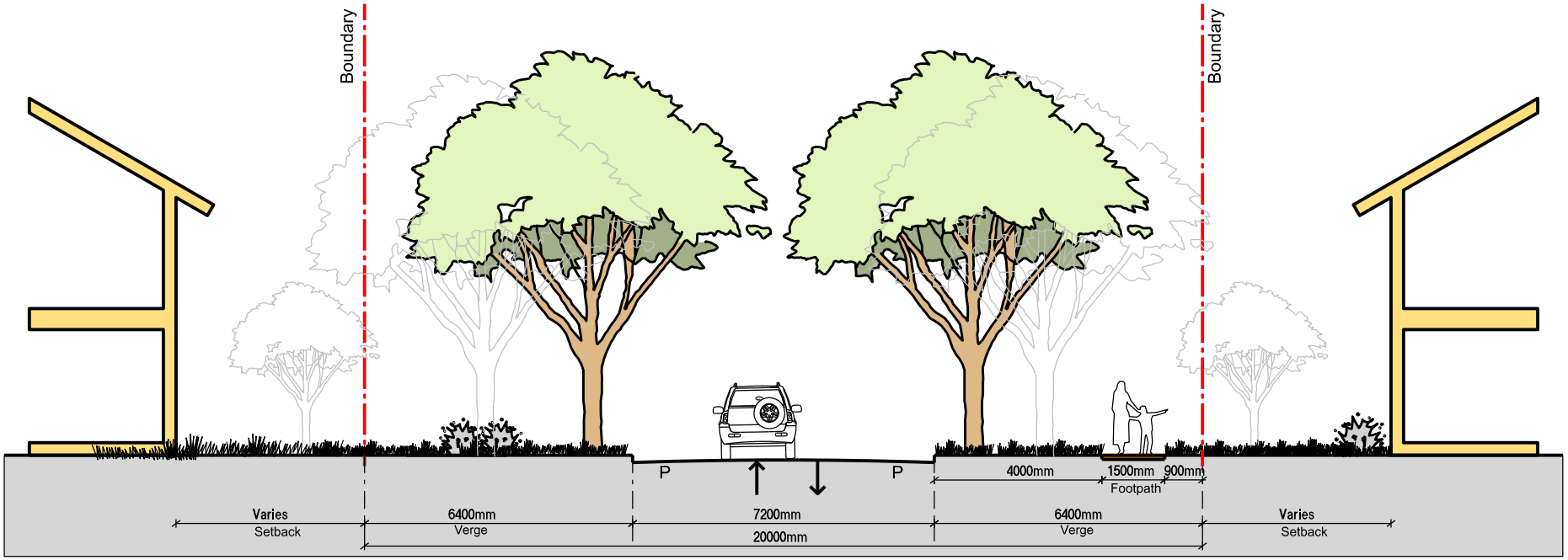
Section E4



Access Street - APZ Edge

Hike/Bike Trail and Footpath are Optional

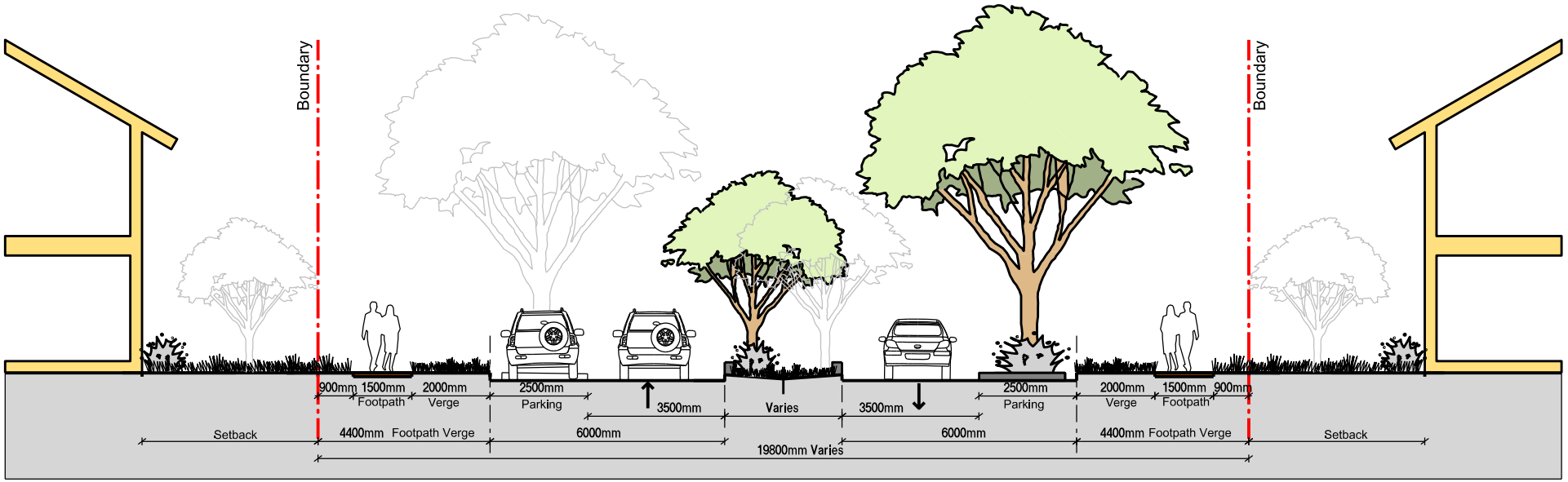
Section E5



Access Street - Country

On Street Parking , Footpath on one side

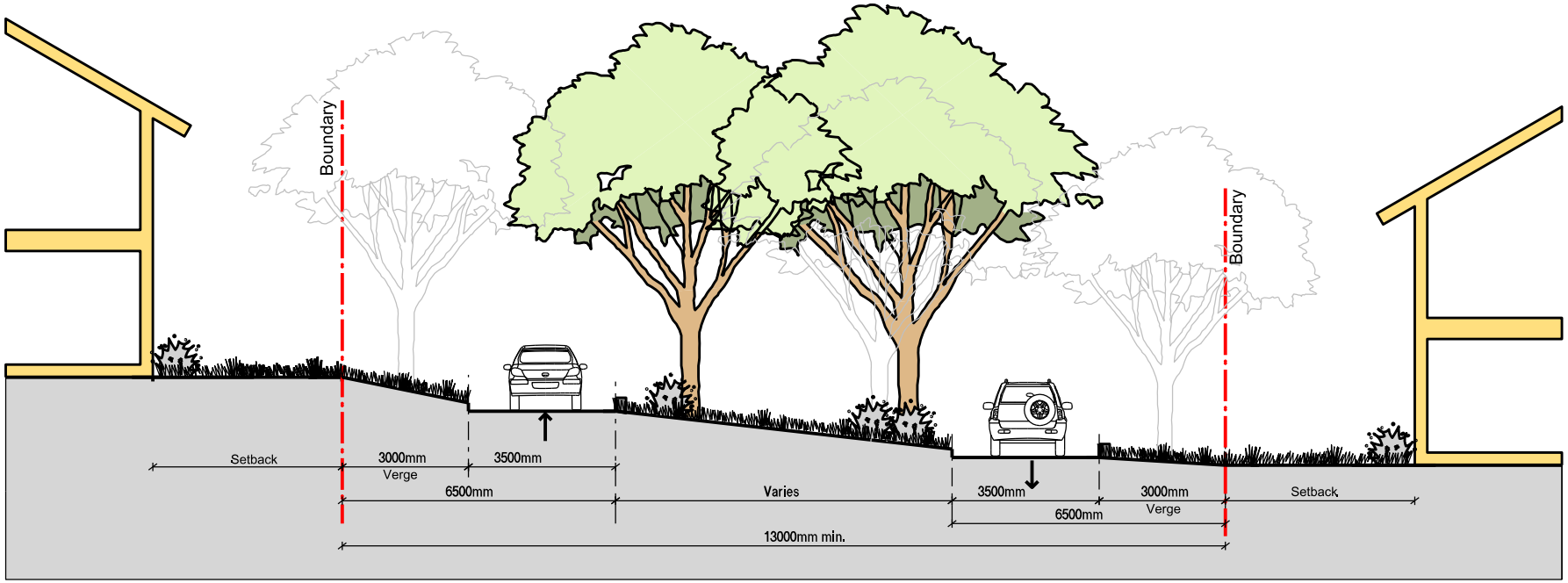
Section E6



Access Street with WSUD Median

Parking Bays on Both Sides, Variable with WSUD Median

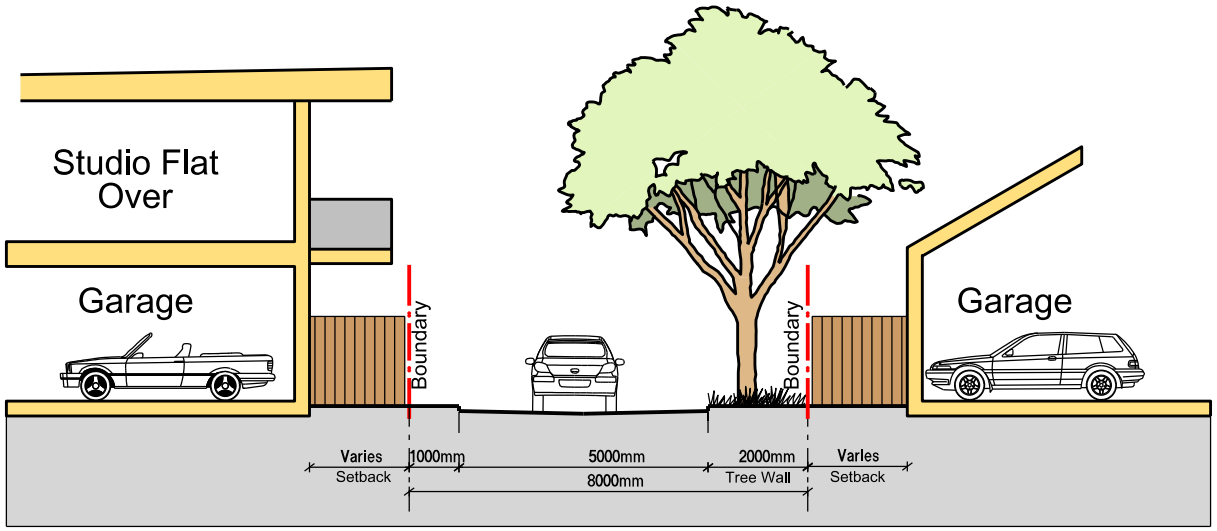
Section E7



Access Street - Hill Side

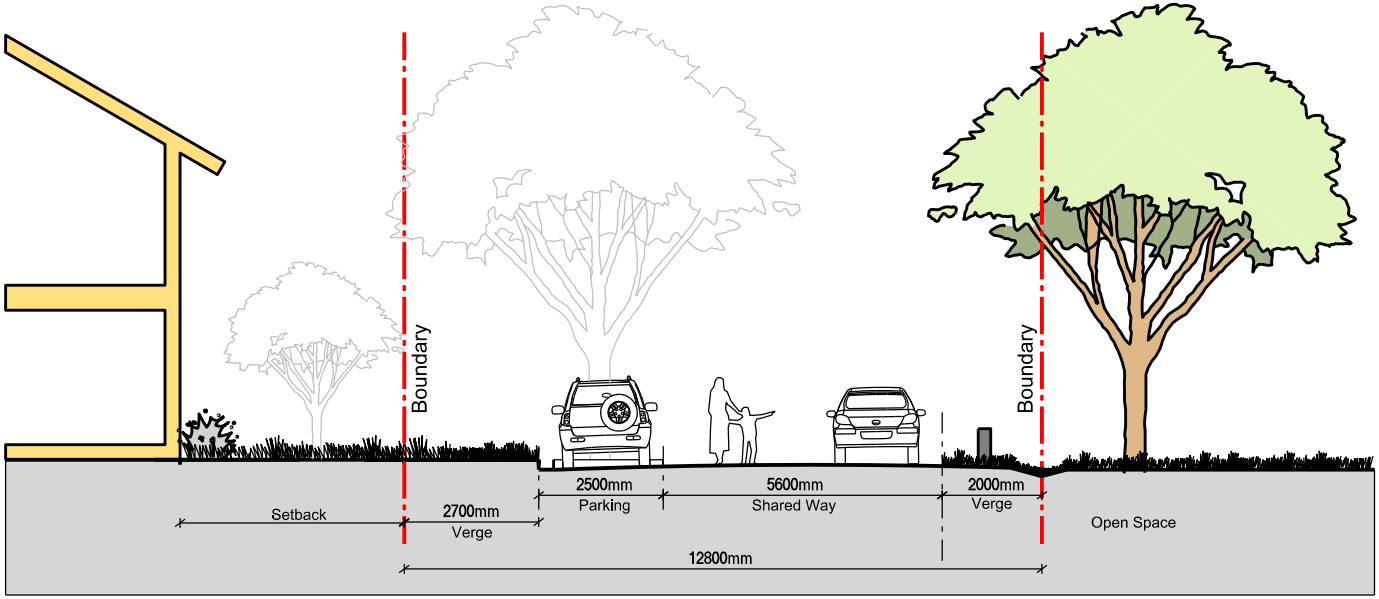
Variable width Carriageway responding to terrain, Passing and parking bays in select locations

Section E8



Lane

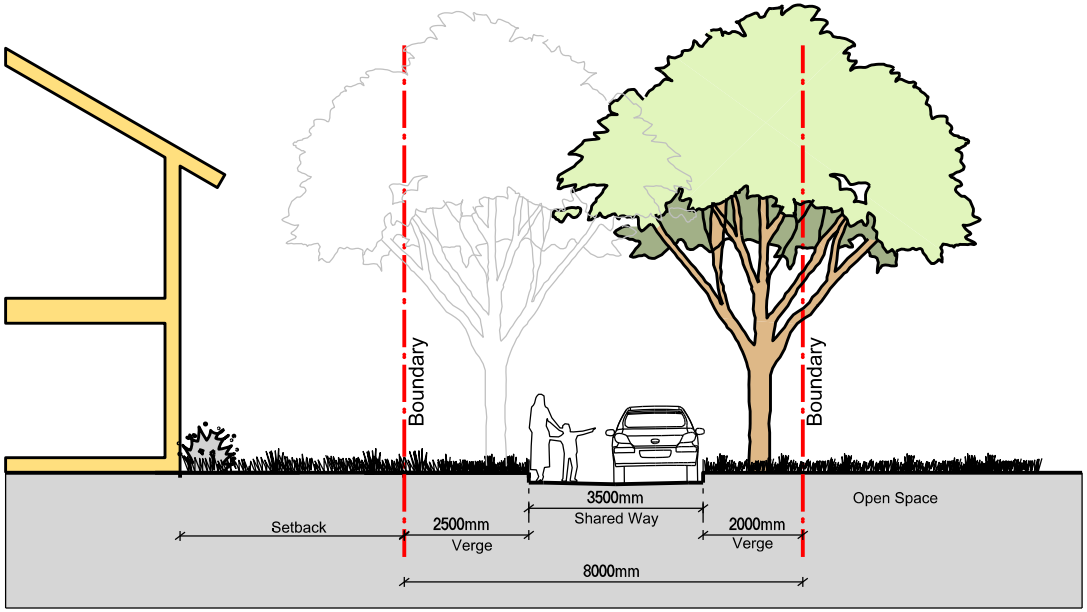
Section F1



Open Space Edge Mews

Parking one side Shared Pedestrian adjacent to open space

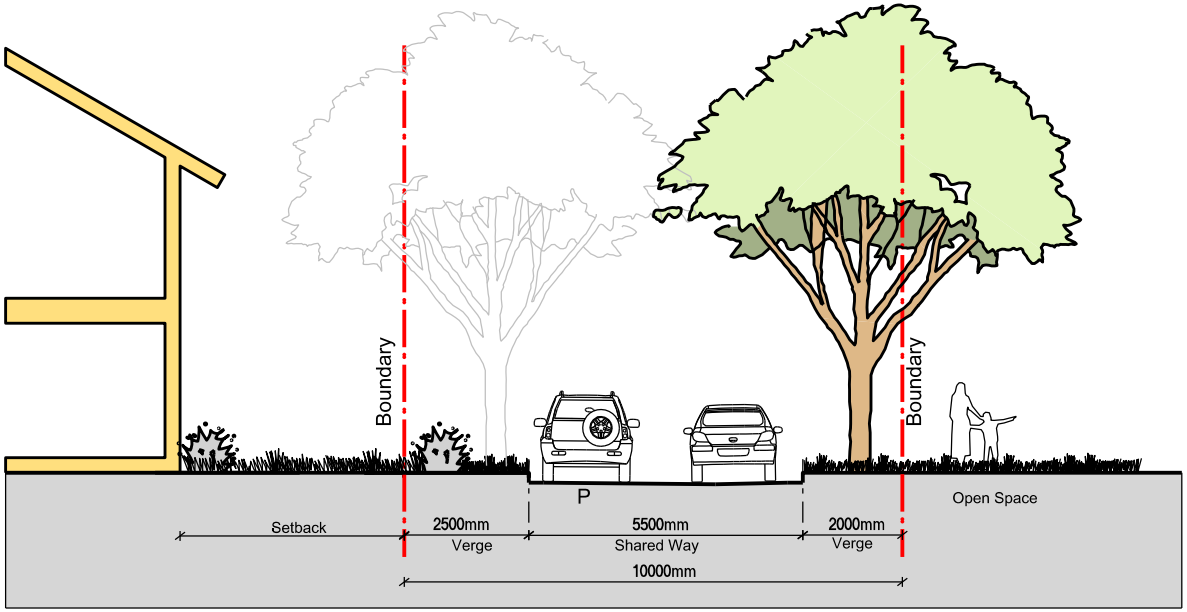
Section F2



Accessway -Mews

No Parking

Section F3



Accessway

Parking one side

Section F4

About Cardno

Cardno is a professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage and deliver sustainable projects and community programs. Cardno is an international company listed on the Australian Securities Exchange [ASX:CDD].

Contact

South Coast Office

16 Burelli Street

Wollongong NSW 2500

Phone: 02 4228 4133

www.cardno.com

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